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Scheller et al.

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(54) **STEERABLE LASER PROBE**

(71) Applicant: **Katalyst Surgical, LLC**, Chesterfield, MO (US)

(72) Inventors: **Gregg D Scheller**, Wildwood, MO (US); **Matthew N Zeid**, Ballwin, MO (US)

(73) Assignee: **Katalyst Surgical, LLC**, Chesterfield, MO (US)

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Related U.S. Application Data

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(51) **Int. Cl.**

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A61F 9/008 (2006.01)
A61B 18/20 (2006.01)
A61B 18/24 (2006.01)
A61B 17/00 (2006.01)
A61B 18/22 (2006.01)

(52) **U.S. Cl.**

CPC ***A61F 9/00821*** (2013.01); *A61B 18/20* (2013.01); *A61B 18/22* (2013.01); *A61B 18/24* (2013.01); *A61B 2017/00469* (2013.01); *A61F 2009/00863* (2013.01)

(58) **Field of Classification Search**

CPC A61B 18/24; A61B 18/22; A61F 9/00821
USPC 606/4
See application file for complete search history.

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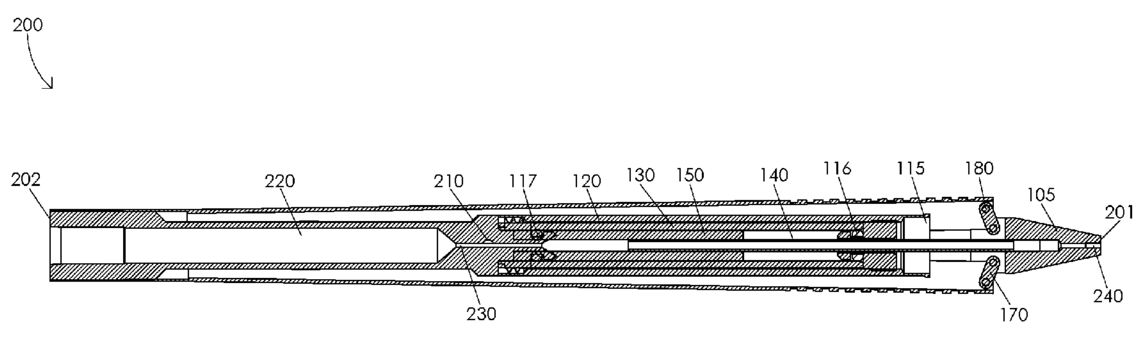
Primary Examiner — Lynsey Crandall
Assistant Examiner — Sebastian X Lukjan
(74) *Attorney, Agent, or Firm* — Kevin P. Rollins

(57) **ABSTRACT**

A steerable laser probe may include an actuation structure, a nosecone fixed to the actuation structure by one or more links and one or more link pins, a flexible housing tube, and an optic fiber disposed in the flexible housing tube and the actuation structure. A compression of the actuation structure may be configured to gradually curve the flexible housing tube and the optic fiber. A decompression of the actuation structure may be configured to gradually straighten the flexible housing tube and the optic fiber.

19 Claims, 27 Drawing Sheets



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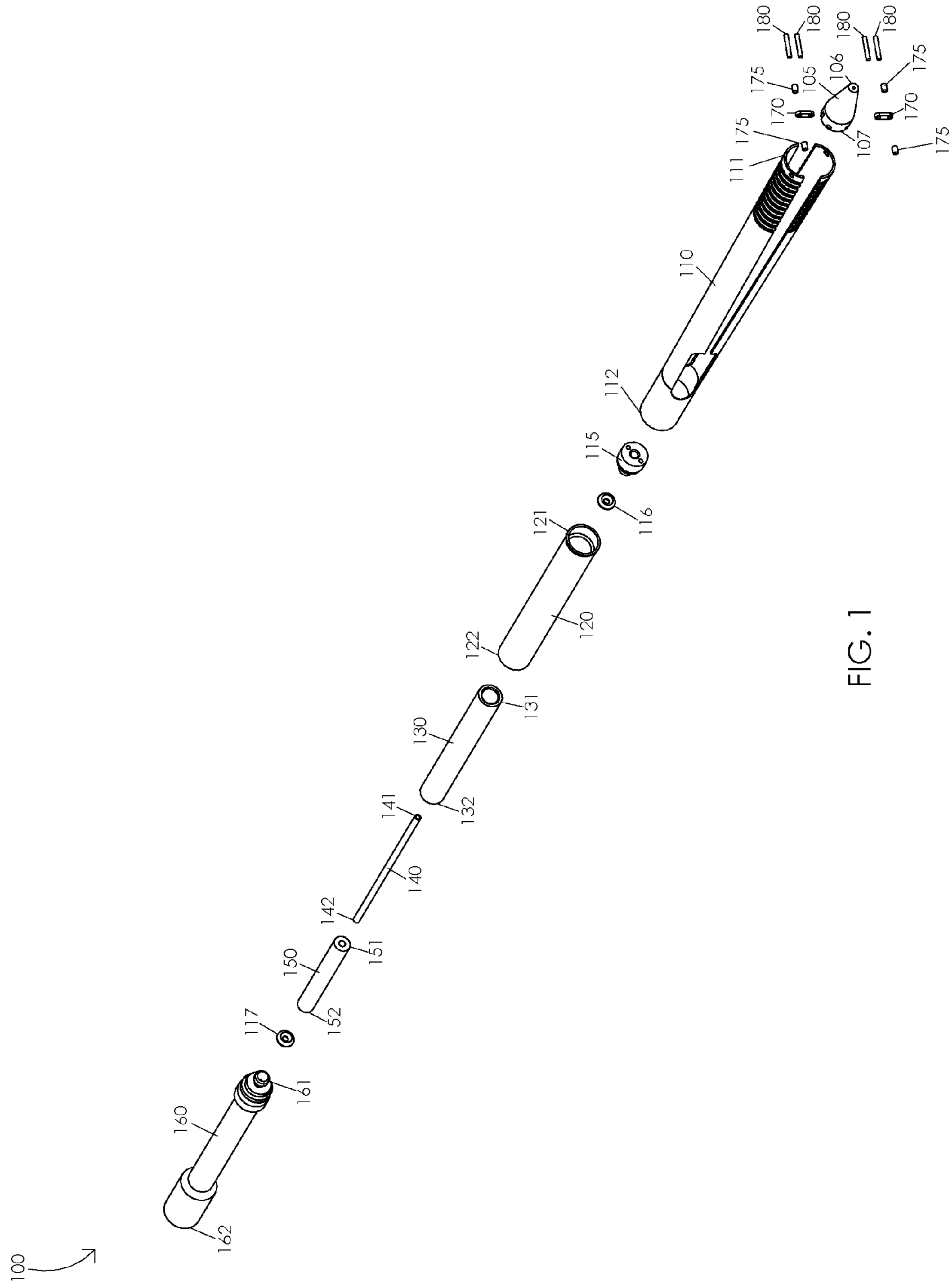
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FIG. 1

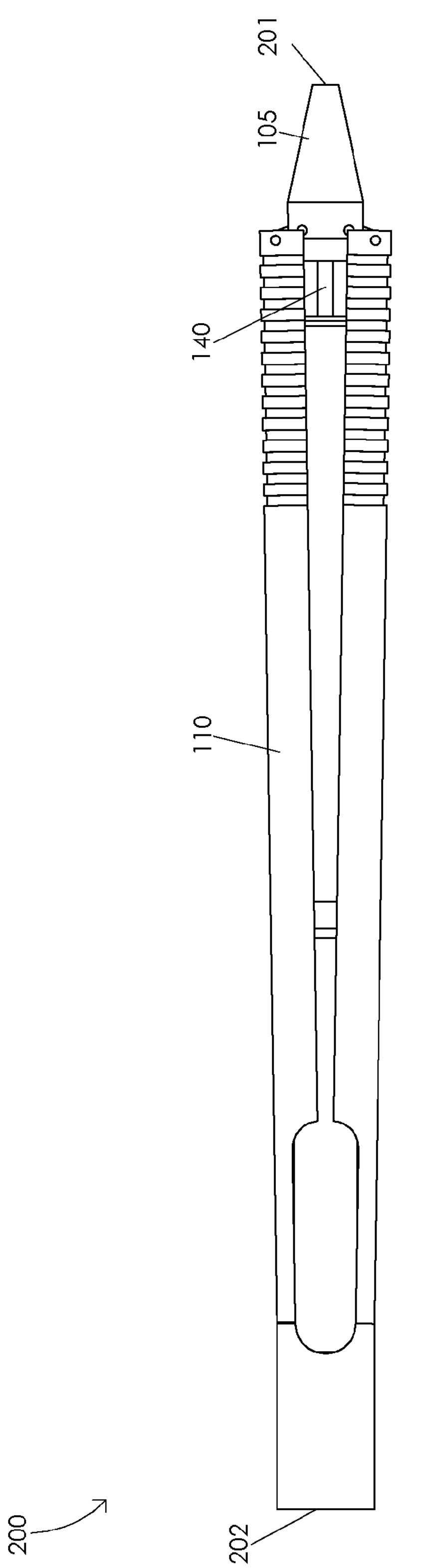
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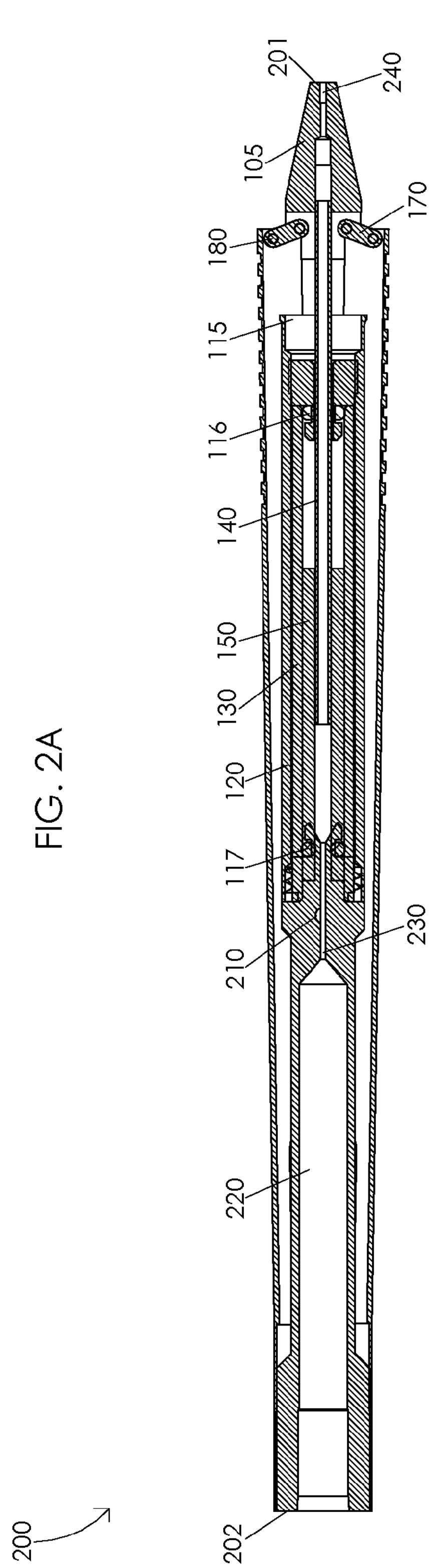
FIG. 2A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200
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FIG. 2B

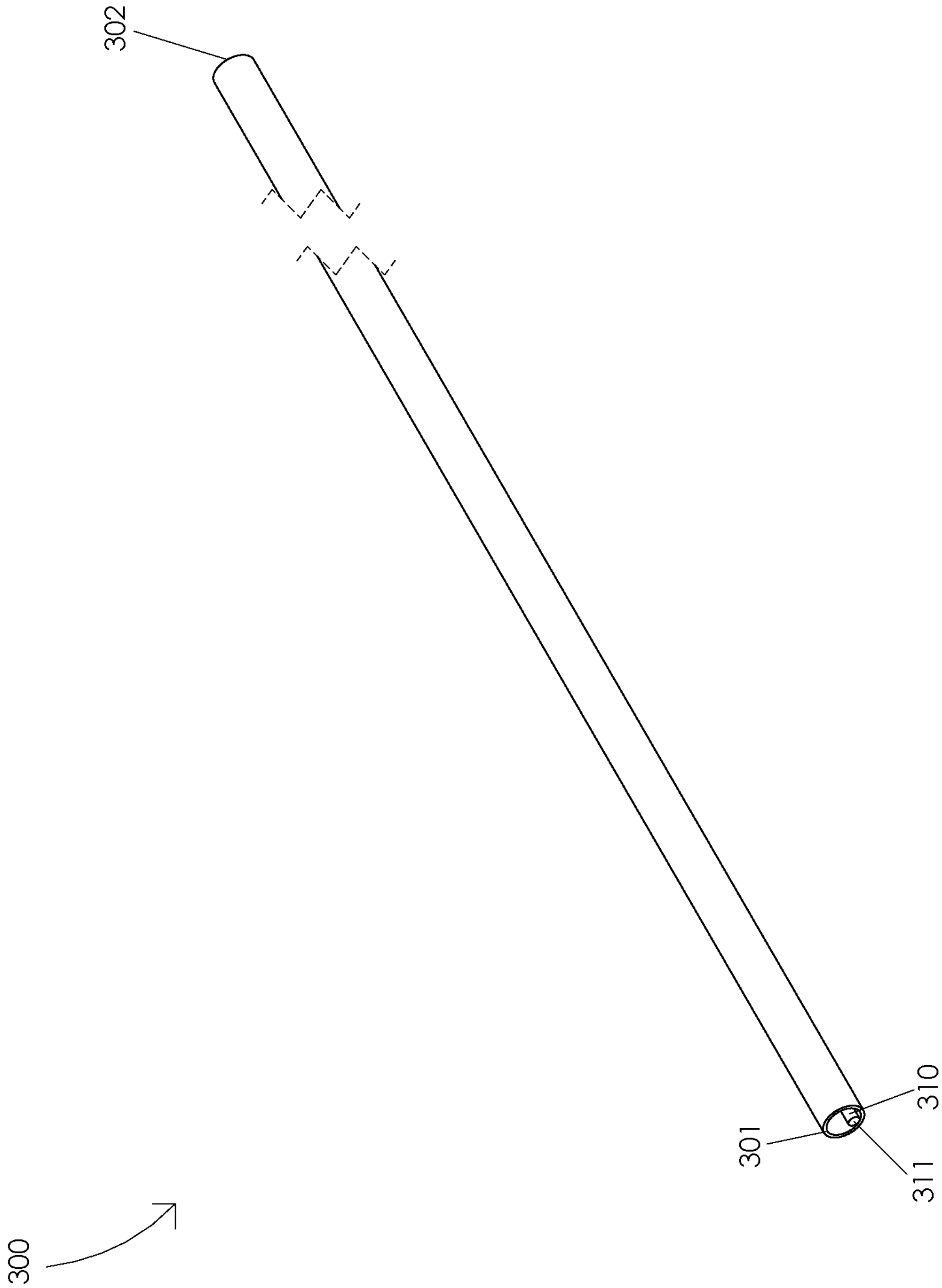

FIG. 3

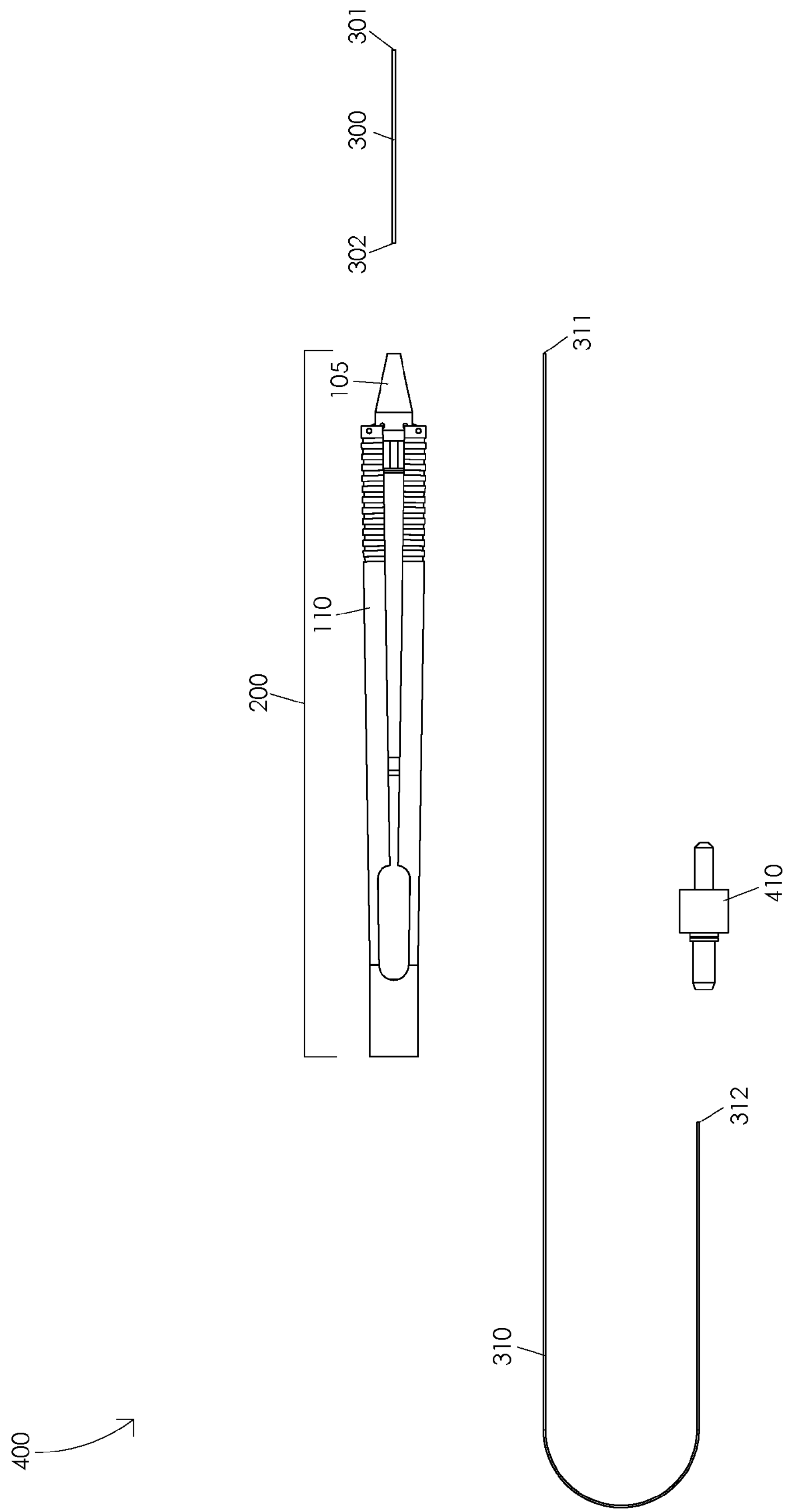

FIG. 4

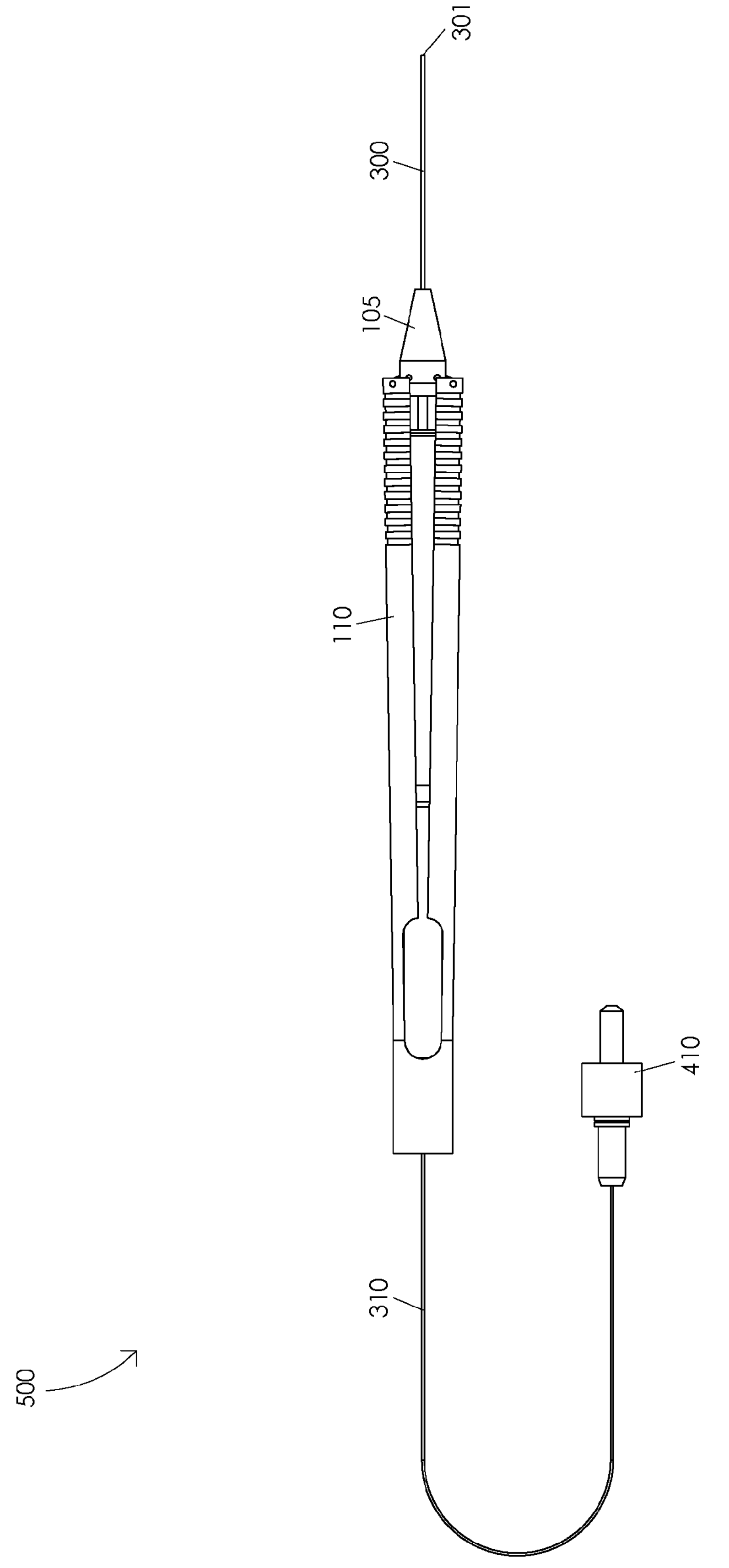

FIG. 5A

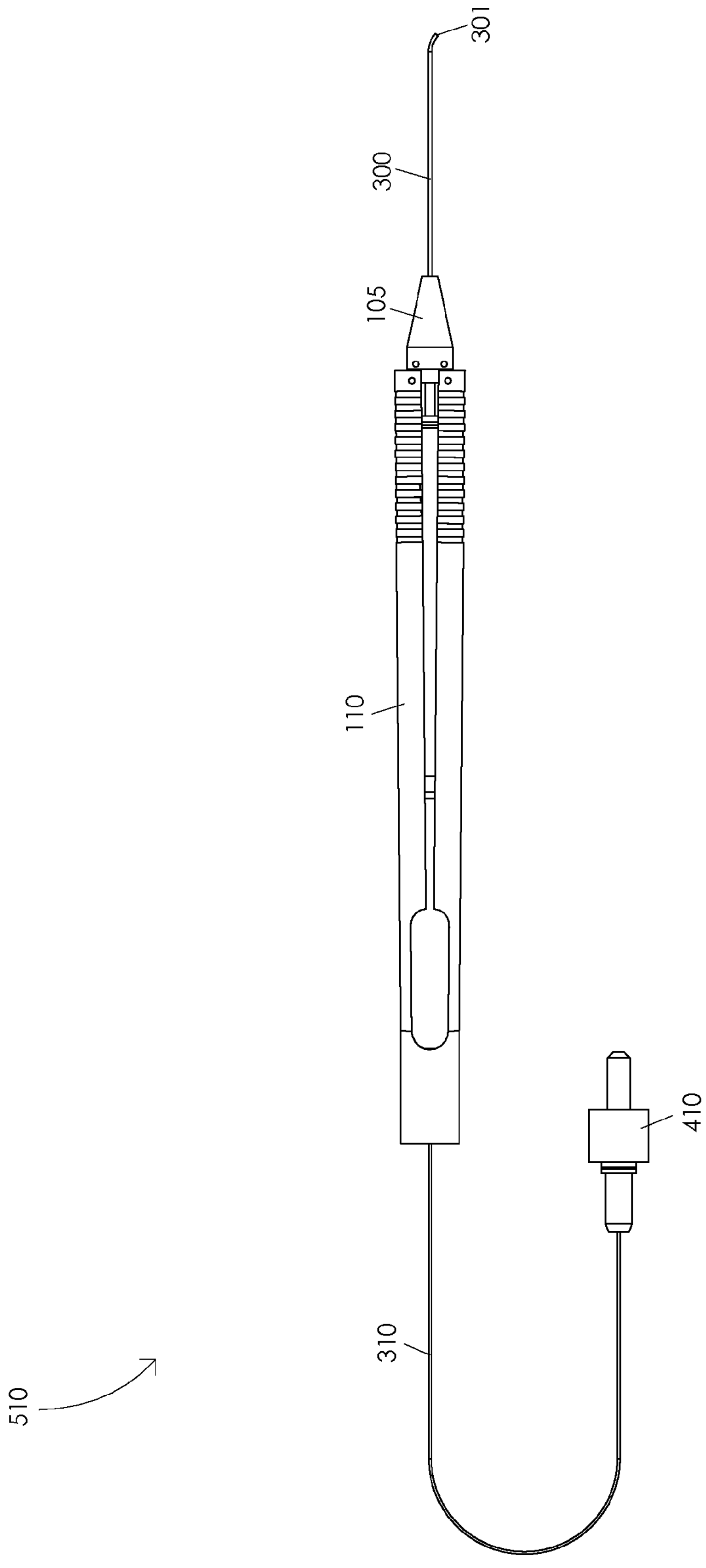

FIG. 5B

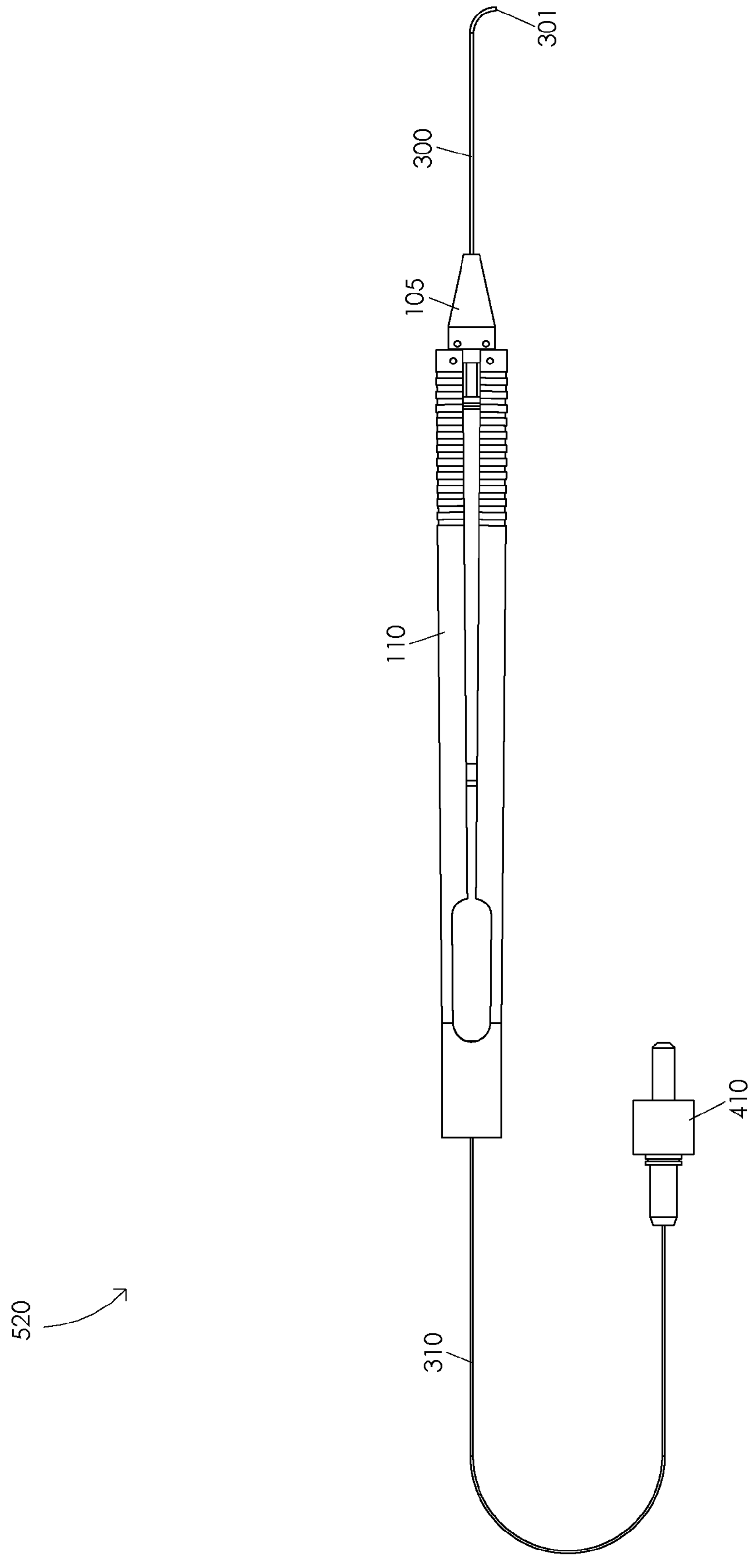

FIG. 5C

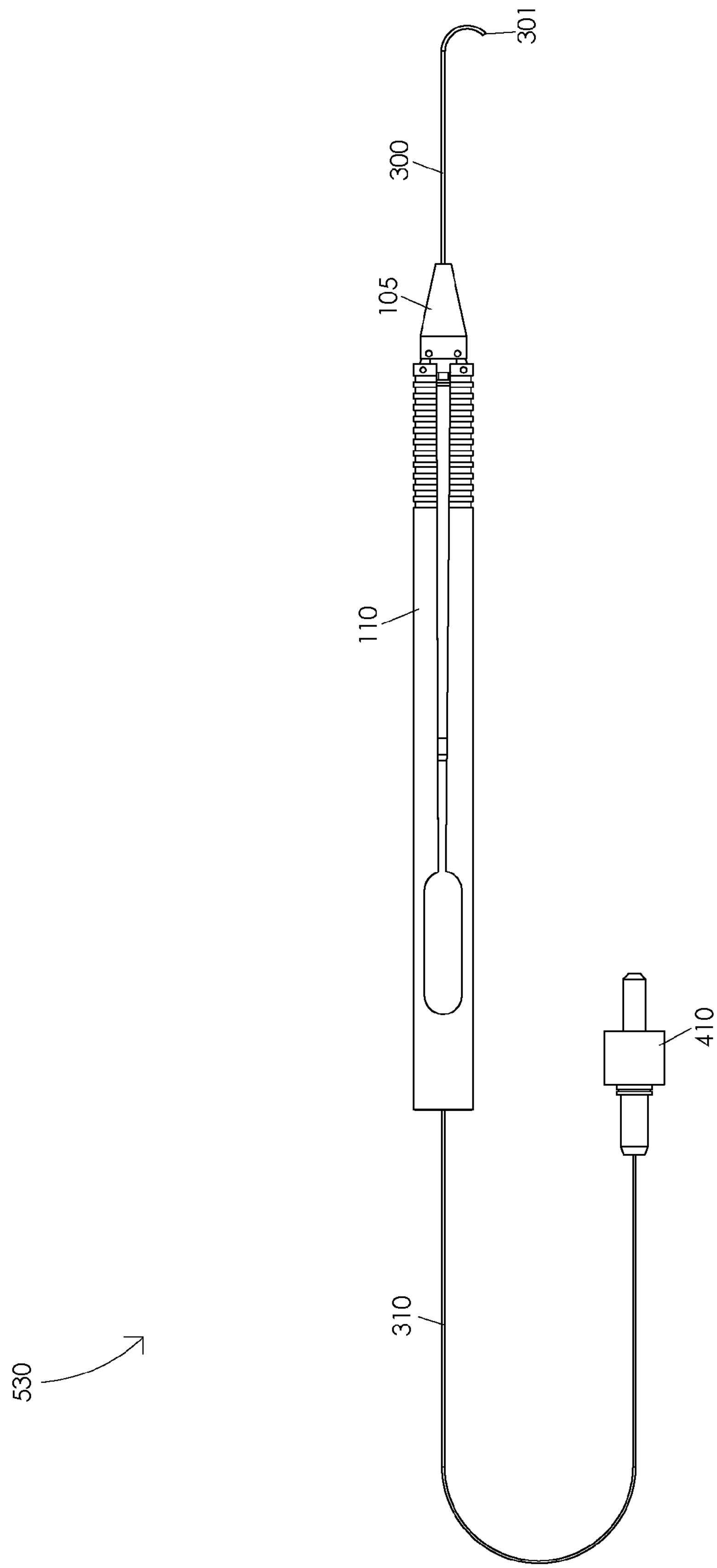

FIG. 5D

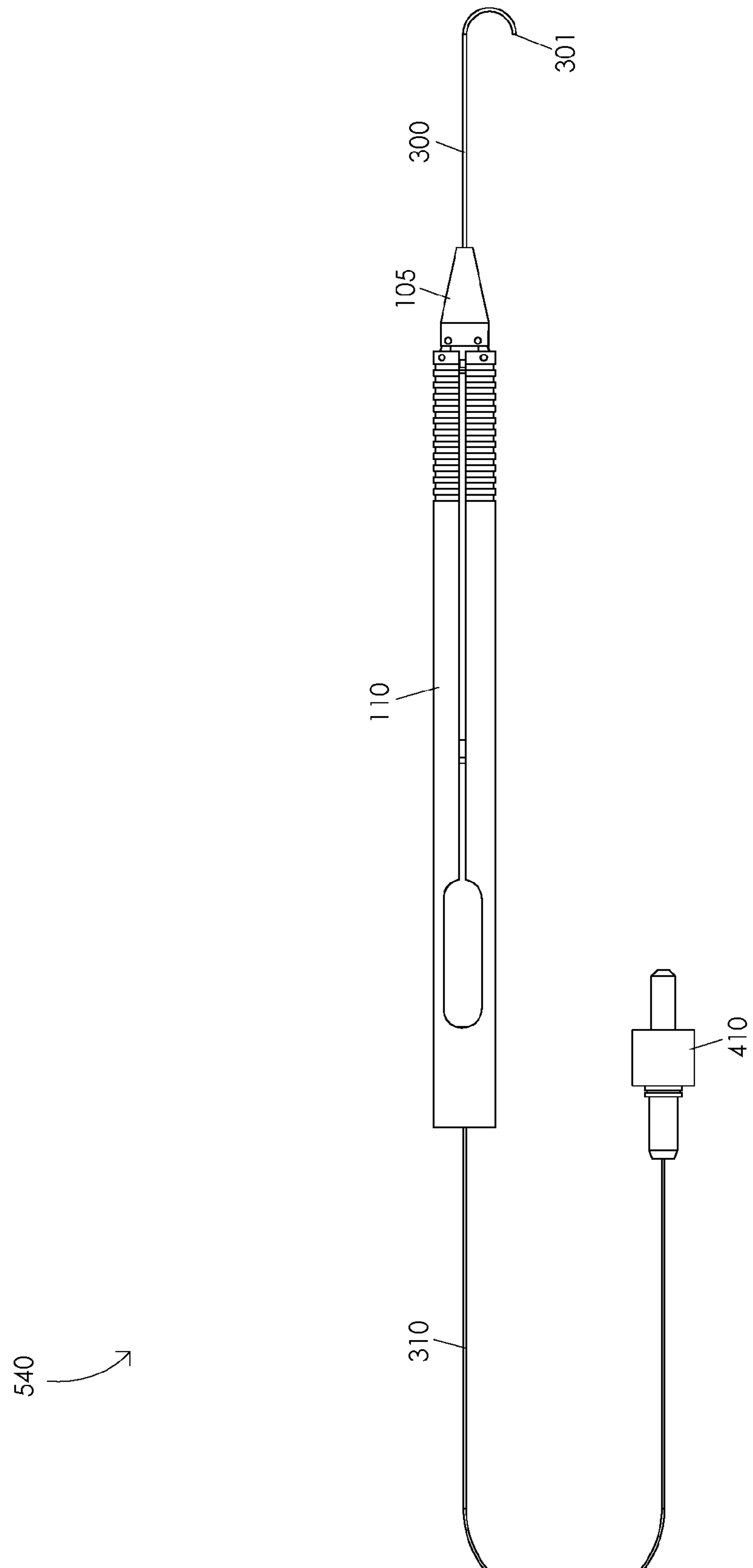

FIG. 5E

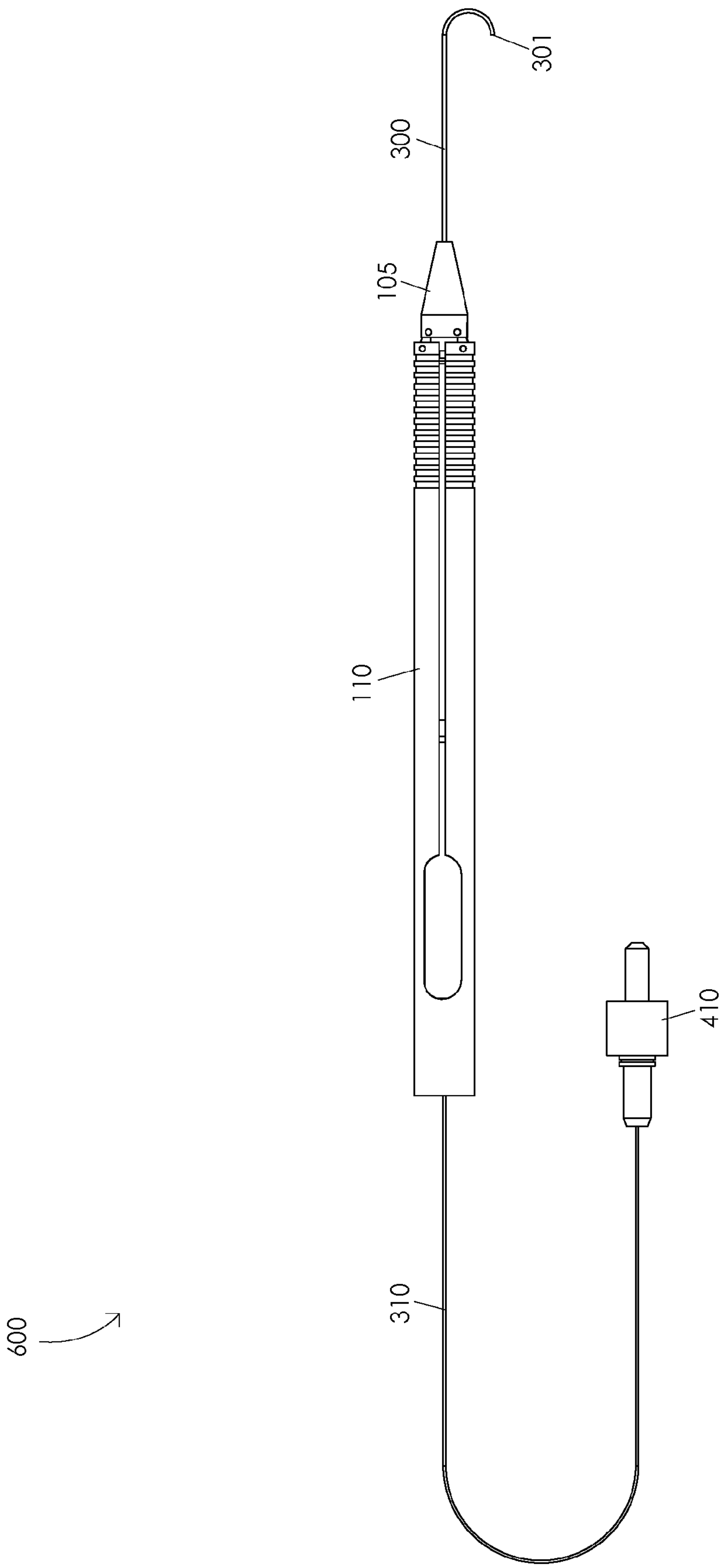

FIG. 6A

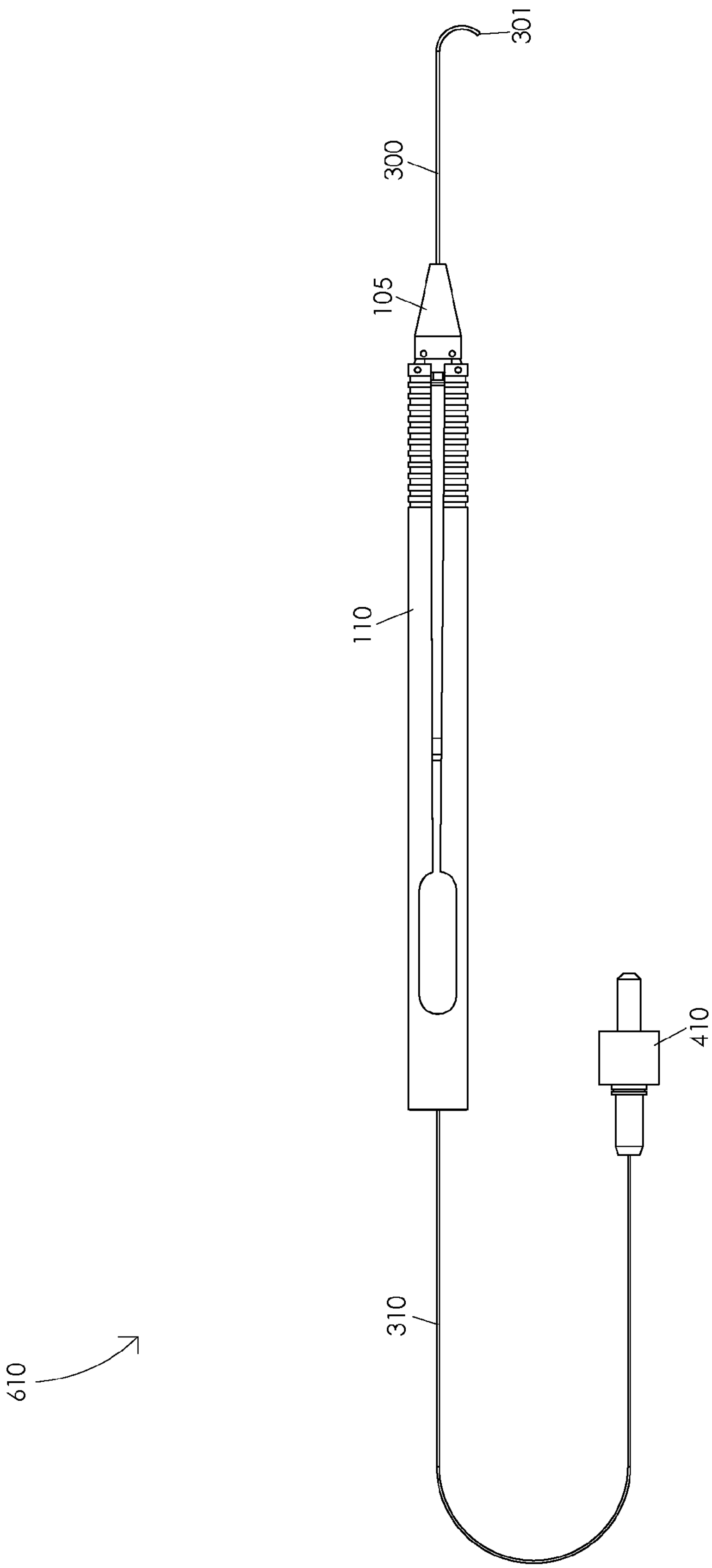

FIG. 6B

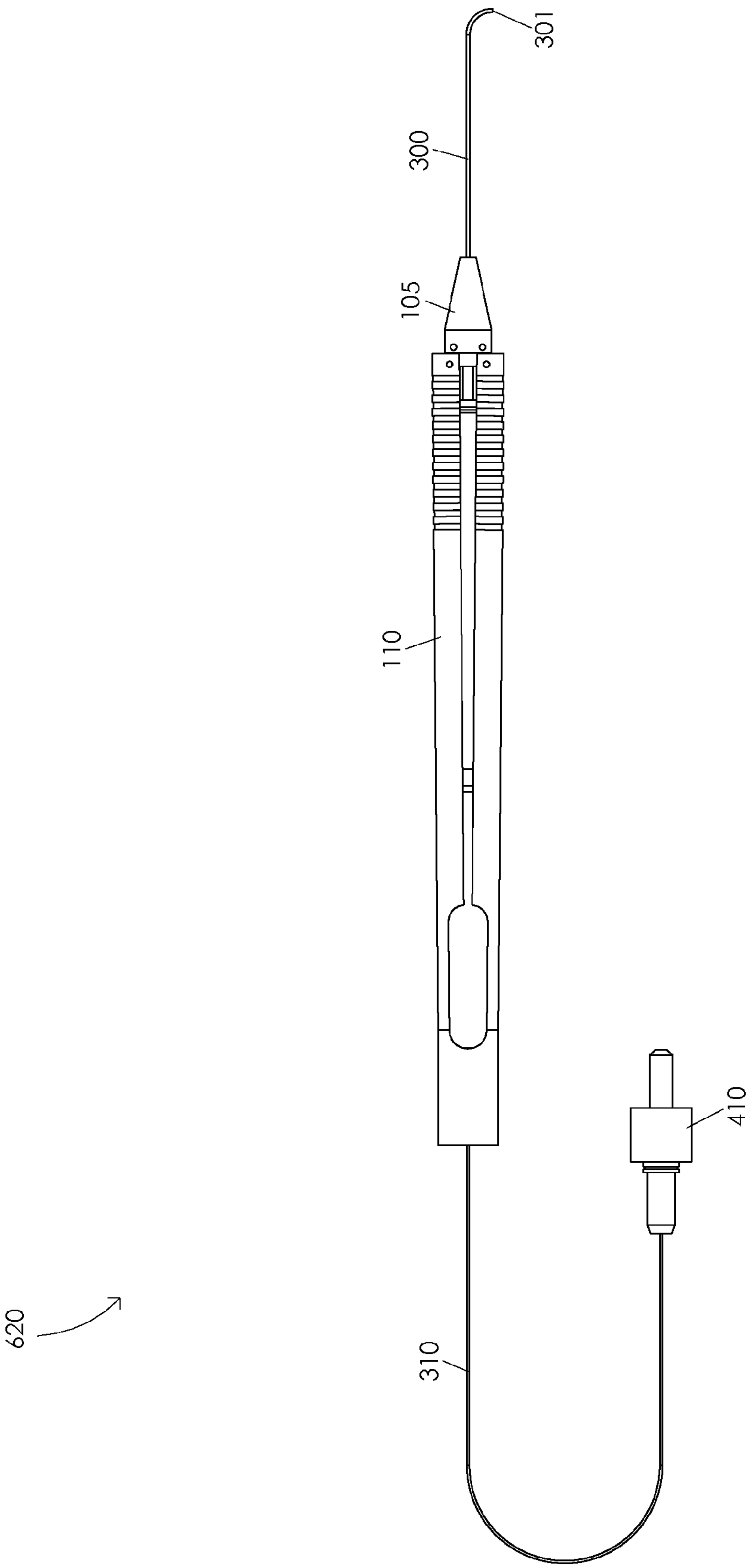

FIG. 6C

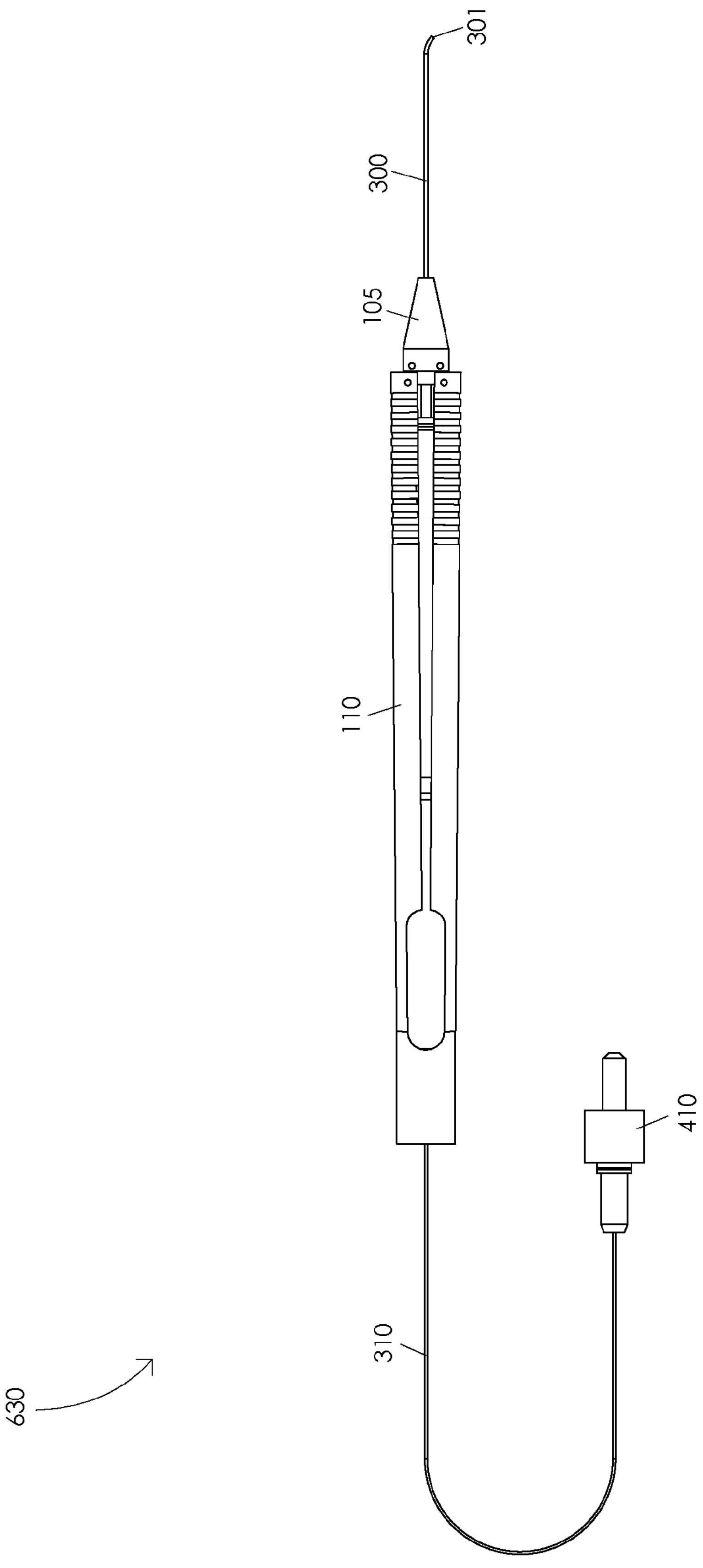

FIG. 6D

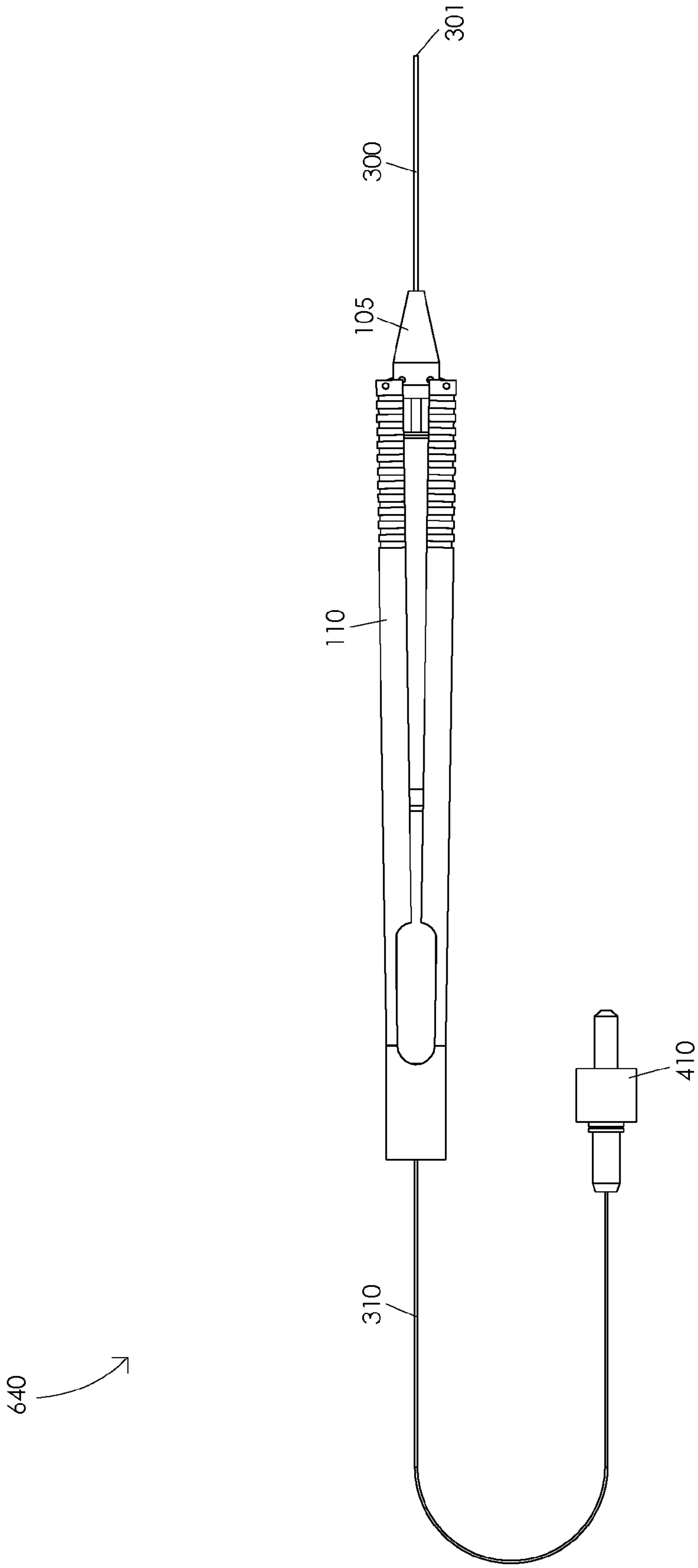

FIG. 6E

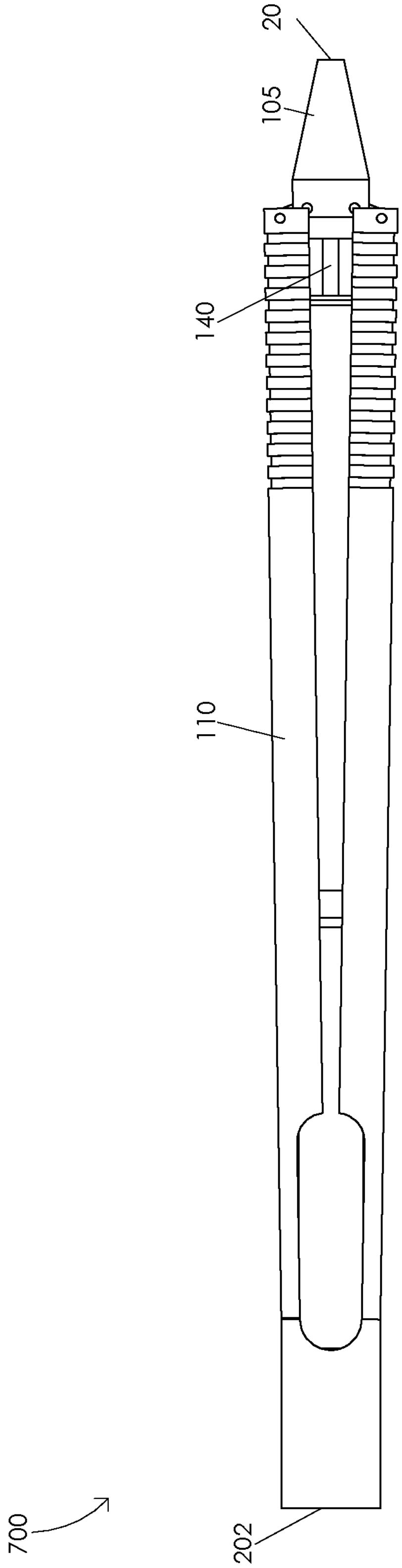
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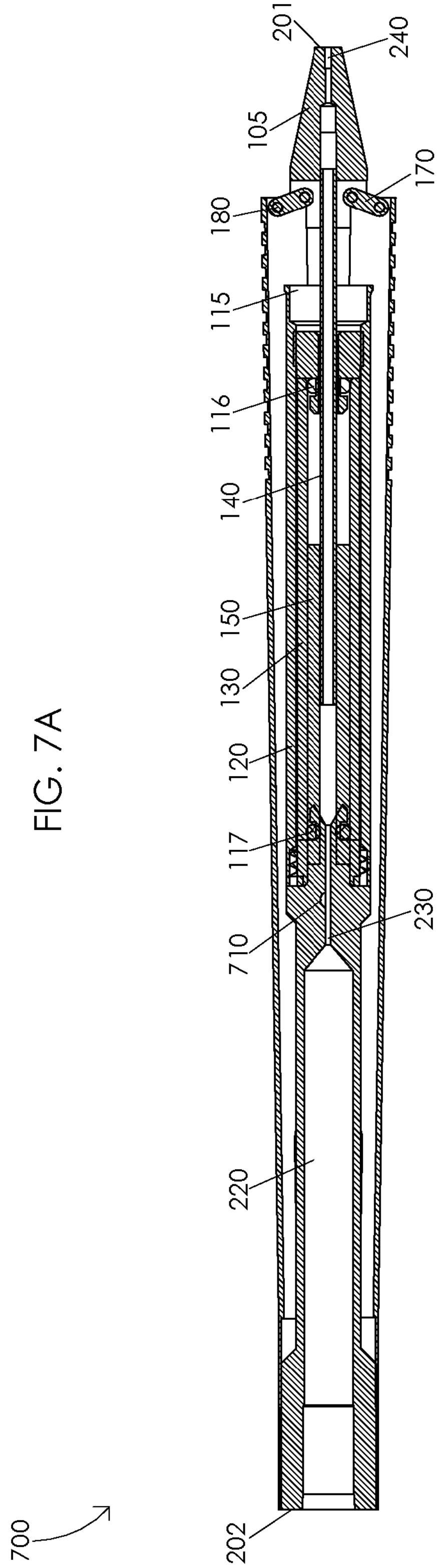
FIG. 7A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710
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700
202

FIG. 7B

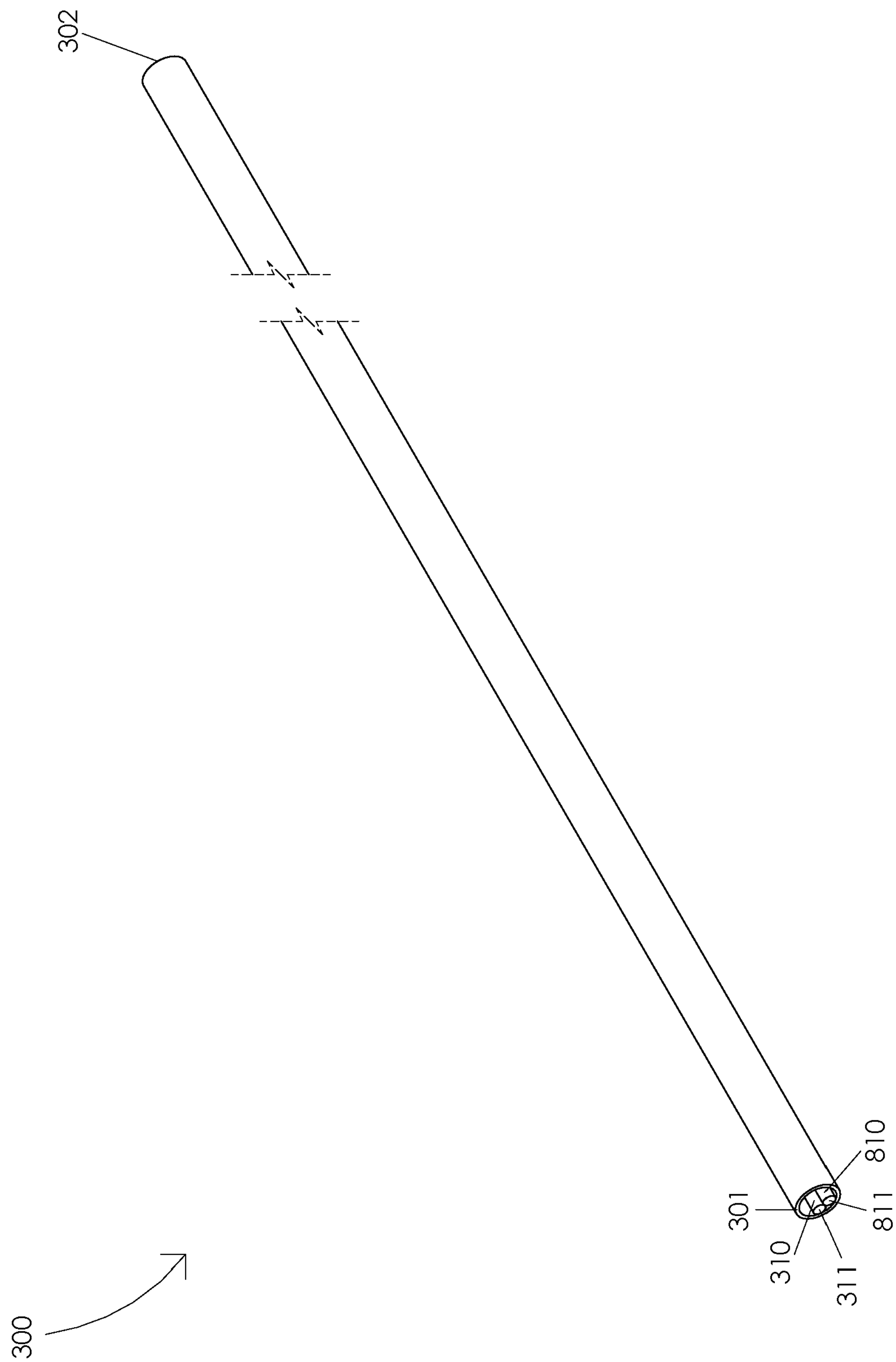

FIG. 8

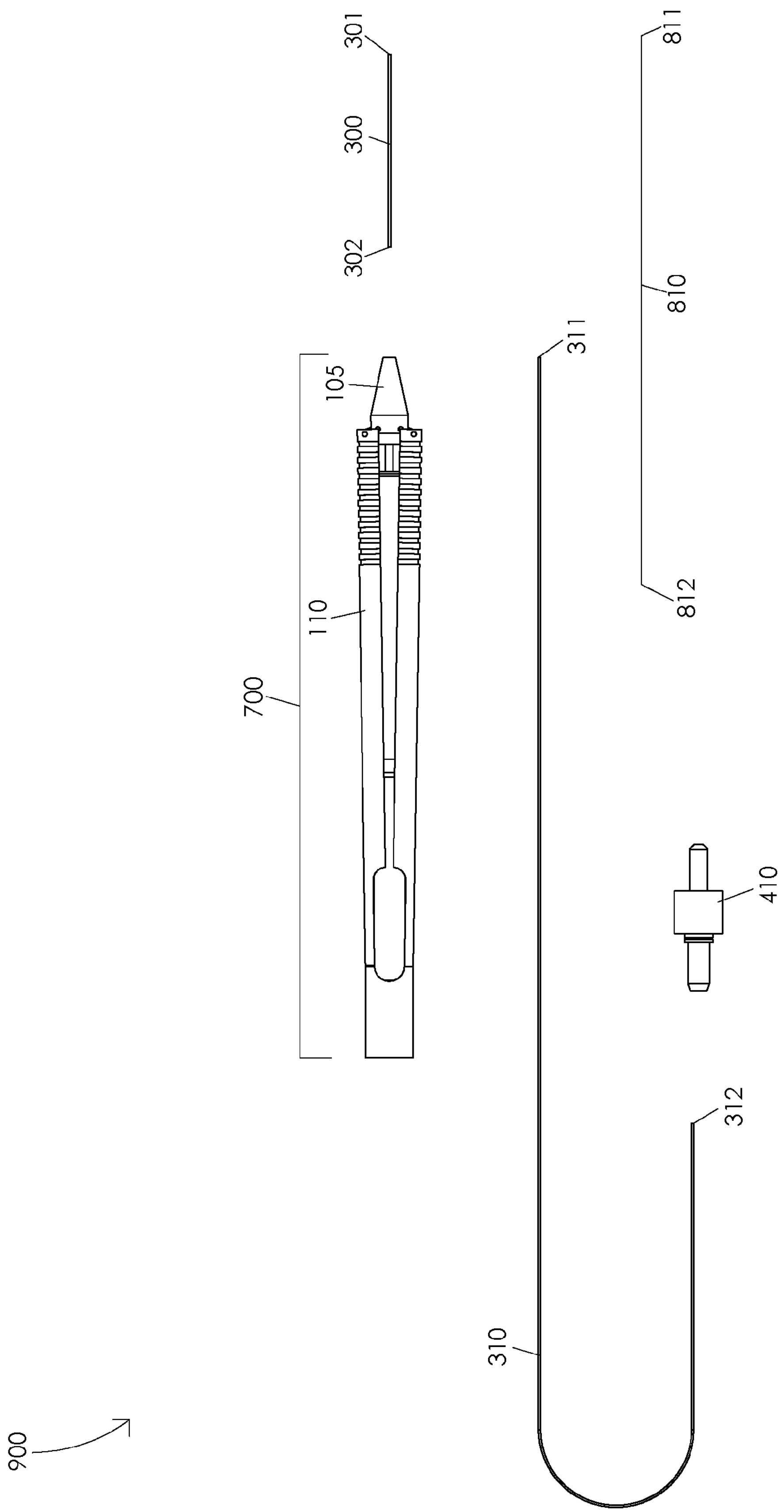

FIG. 9

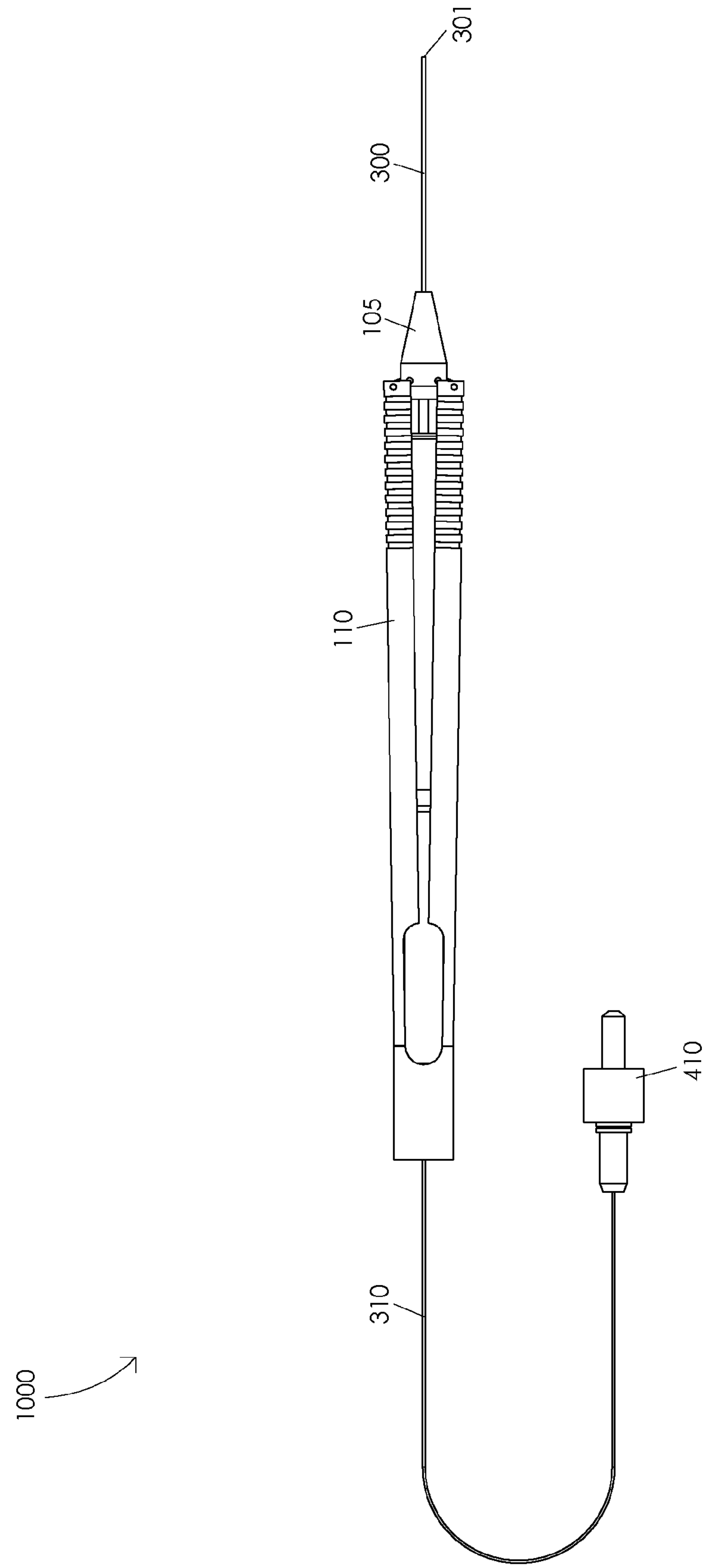

FIG. 10A

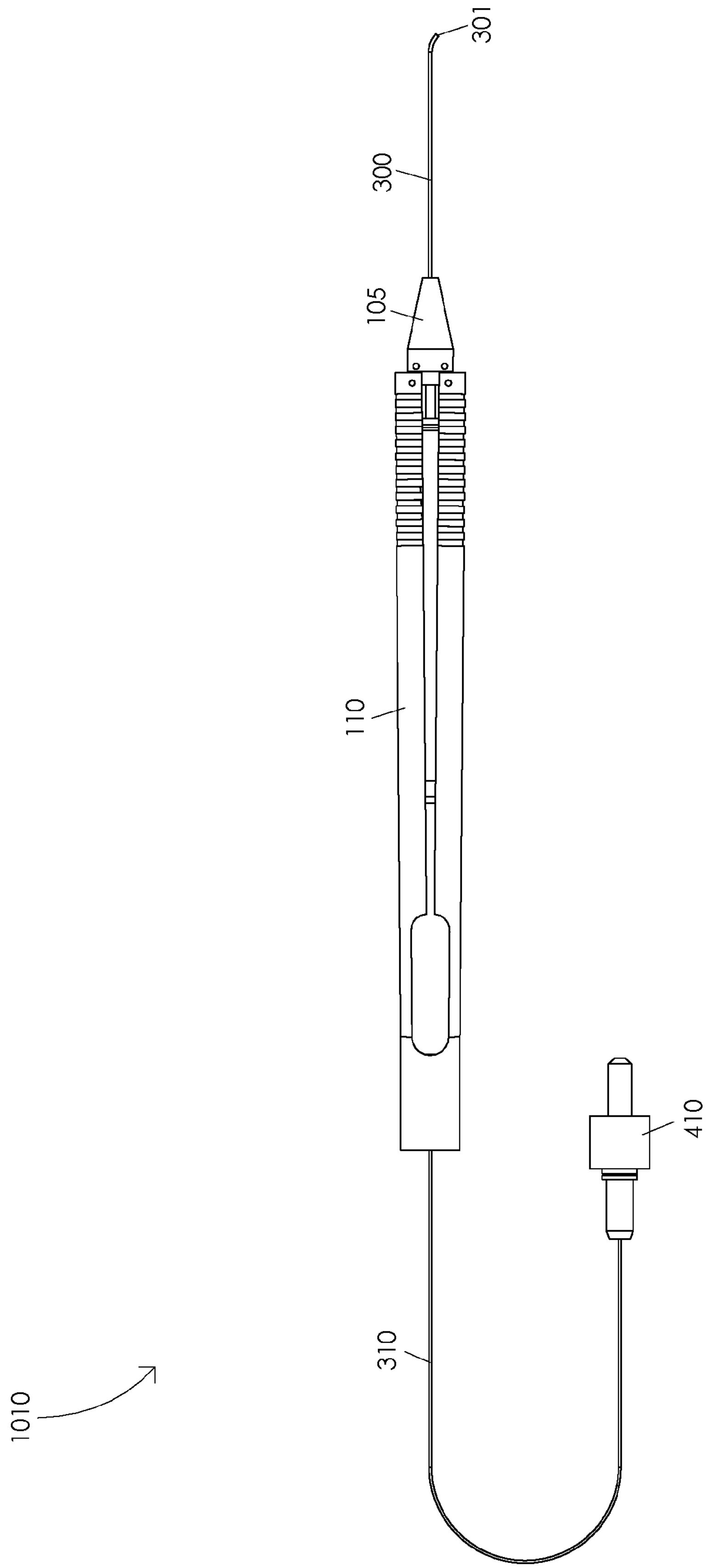

FIG. 10B

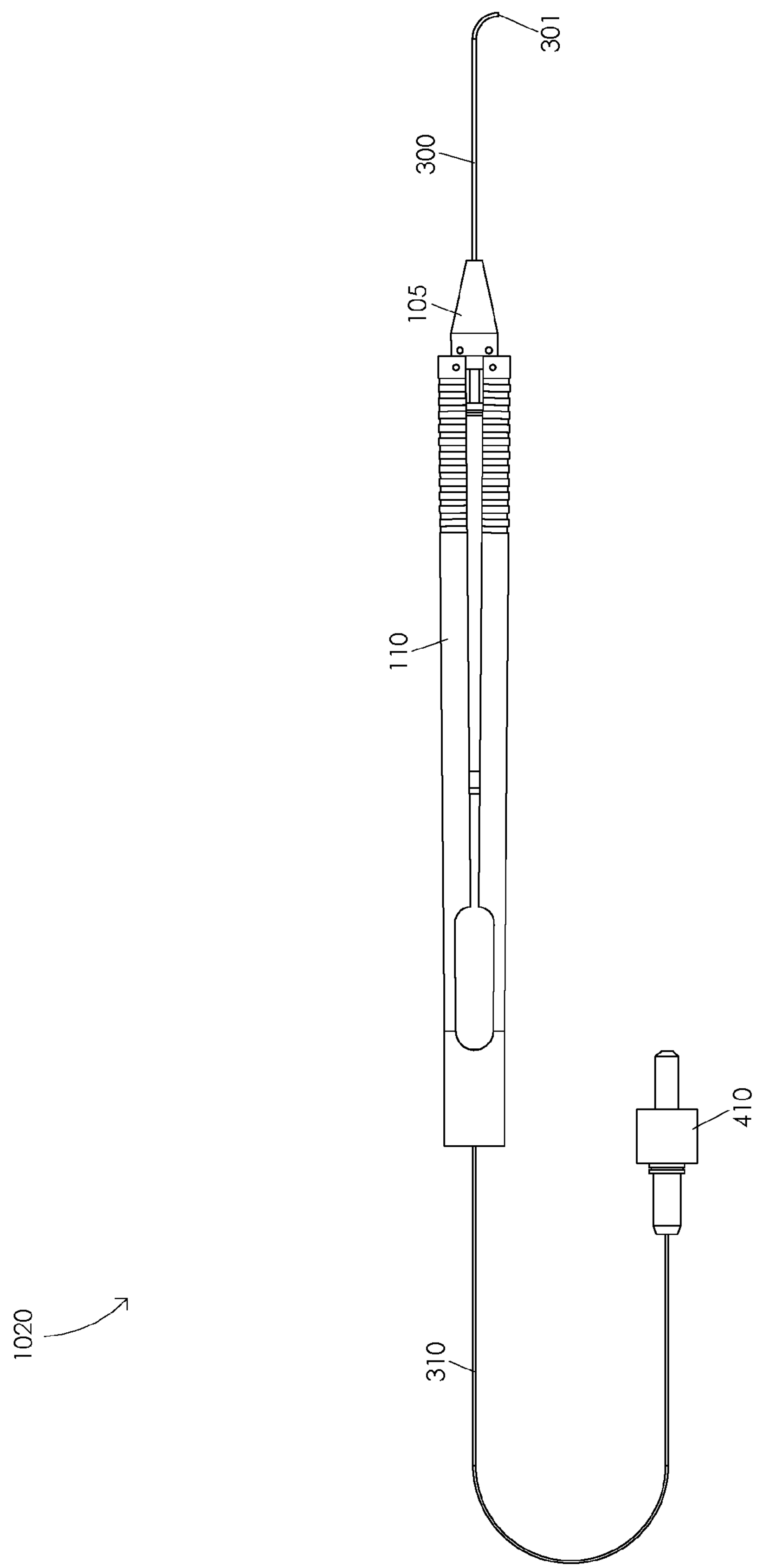

FIG. 10C

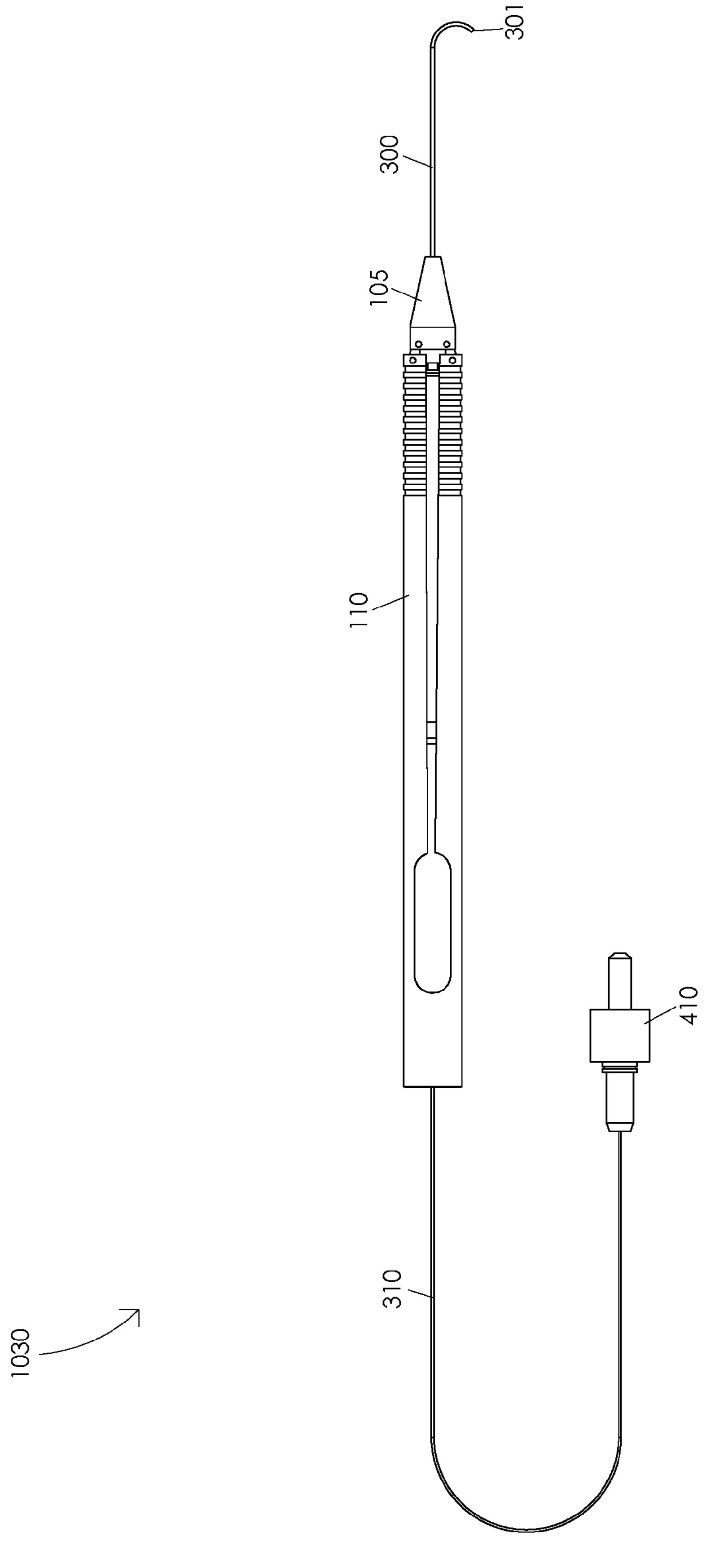

FIG. 10D

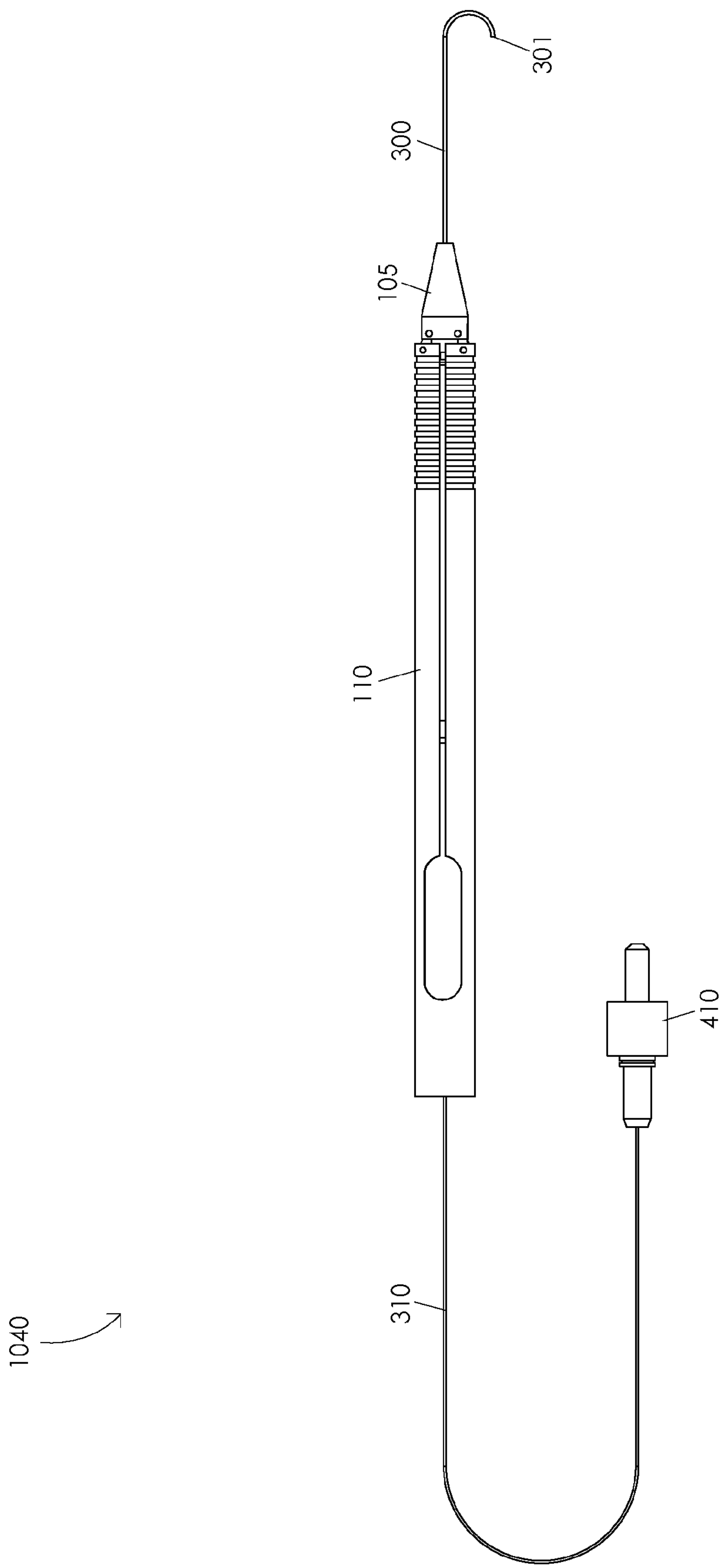

FIG. 10E

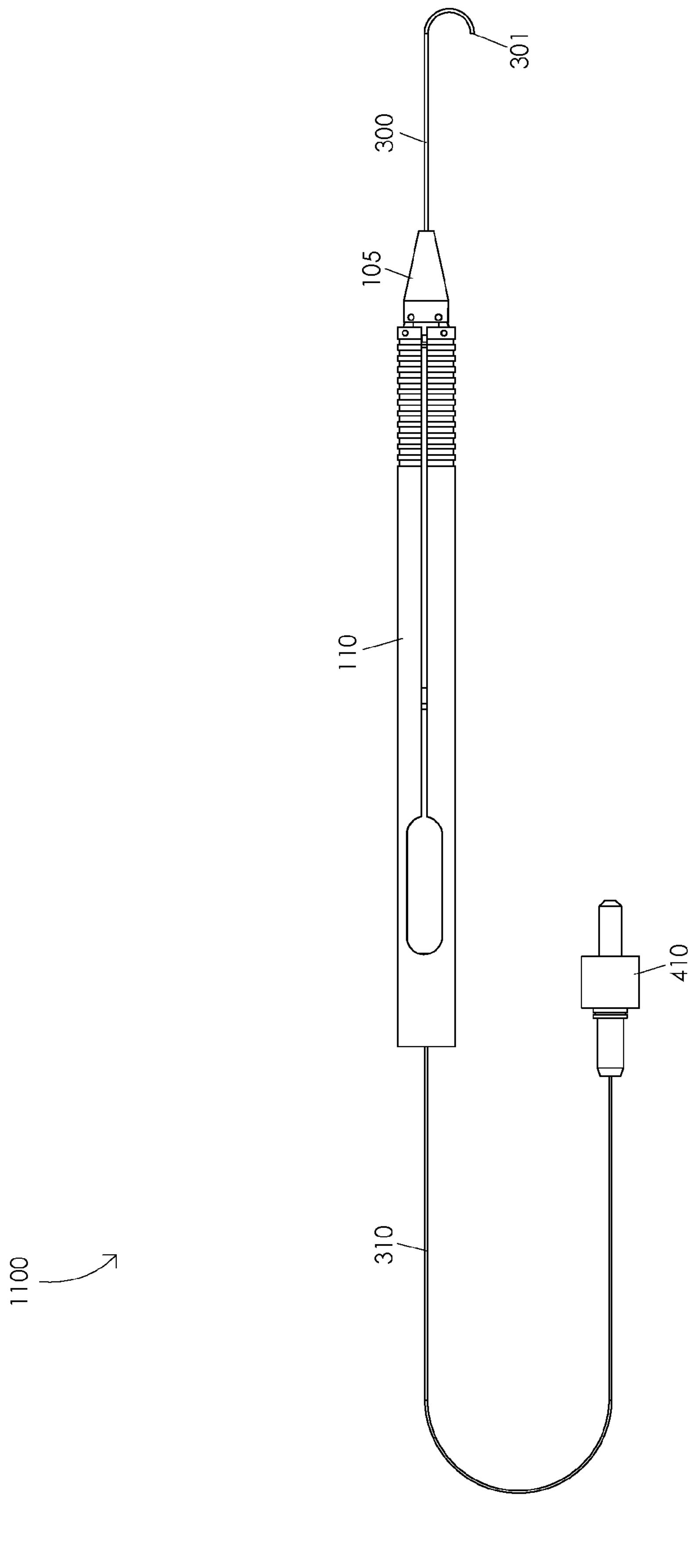

FIG. 11A

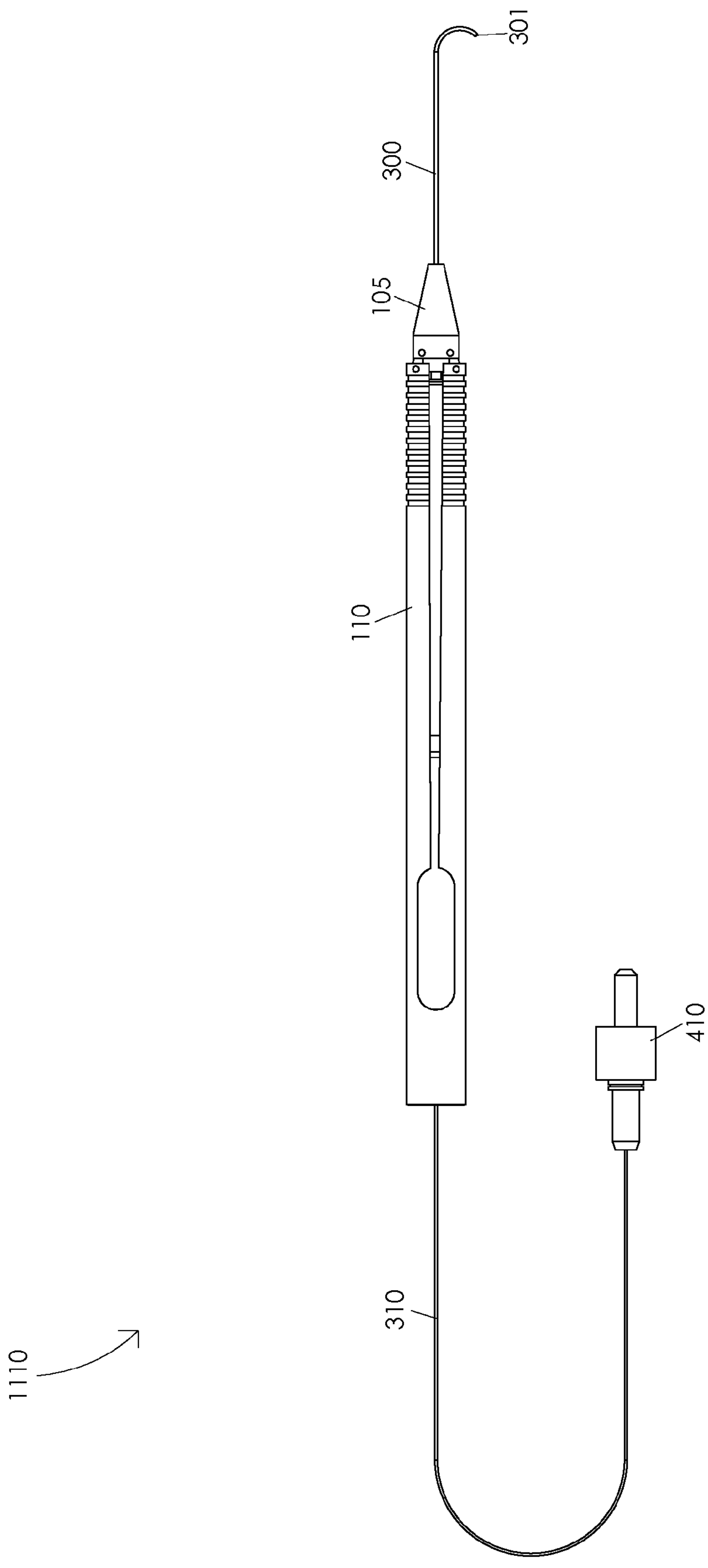

FIG. 11B

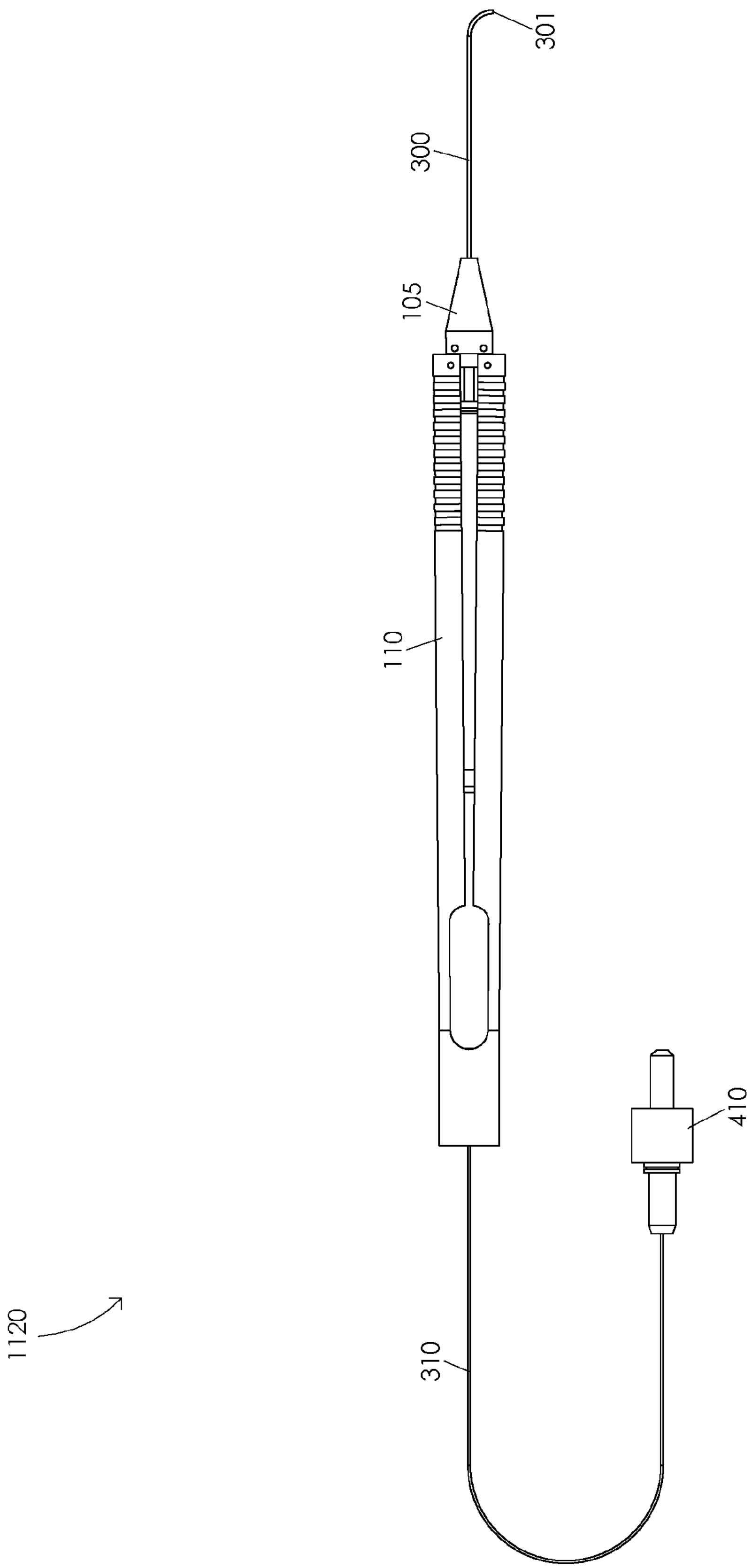

FIG. 11C

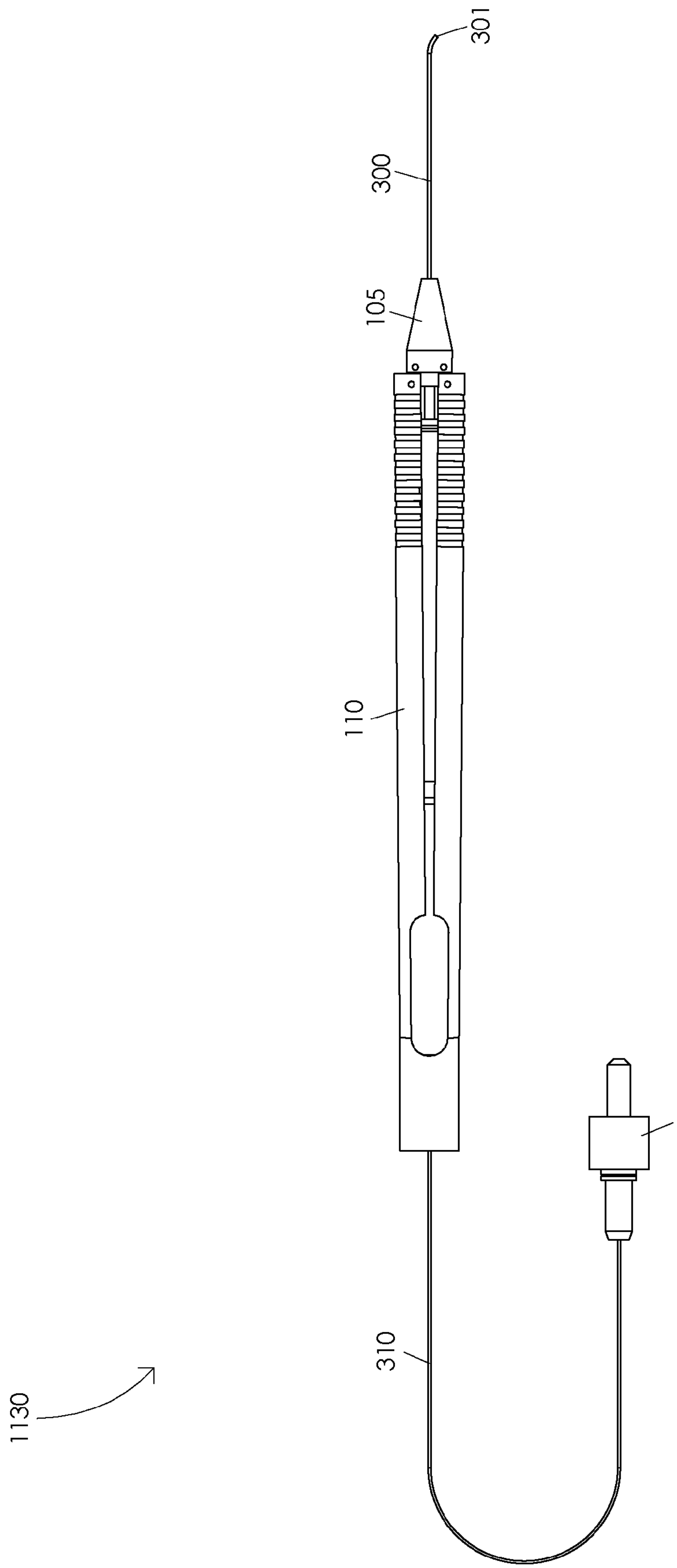

FIG. 11D

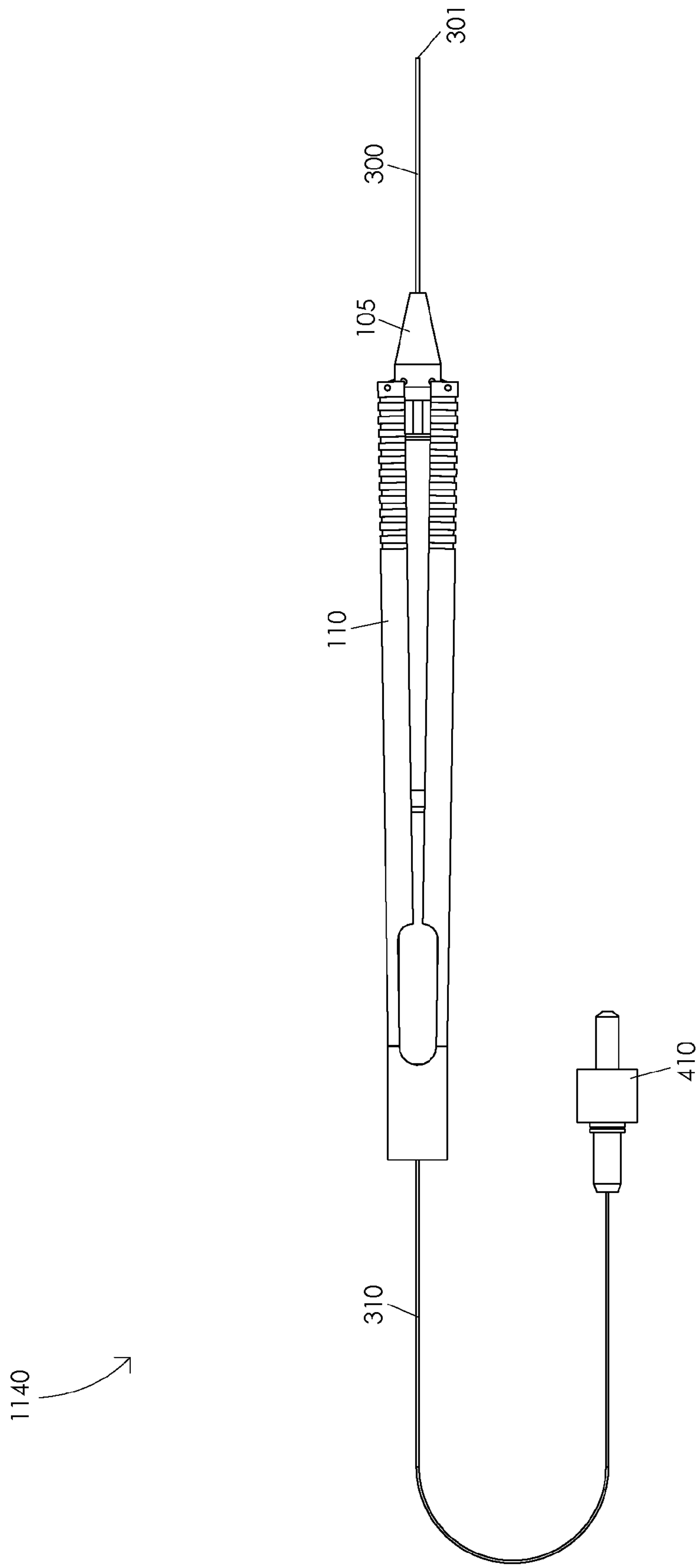

FIG. 11E

STEERABLE LASER PROBE

CROSS-REFERENCE TO RELATED APPLICATIONS

This Application claims the benefit of U.S. Provisional Application No. 61/697,534, filed Sep. 6, 2012.

FIELD OF THE INVENTION

The present disclosure relates to a surgical instrument, and, more particularly, to a steerable laser probe.

BACKGROUND OF THE INVENTION

A wide variety of ophthalmic procedures require a laser energy source. For example, ophthalmic surgeons may use laser photocoagulation to treat proliferative retinopathy. Proliferative retinopathy is a condition characterized by the development of abnormal blood vessels in the retina that grow into the vitreous humor. Ophthalmic surgeons may treat this condition by energizing a laser to cauterize portions of the retina to prevent the abnormal blood vessels from growing and hemorrhaging.

In order to increase the chances of a successful laser photocoagulation procedure, it is important that a surgeon is able aim the laser at a plurality of targets within the eye, e.g., by guiding or moving the laser from a first target to a second target within the eye. It is also important that the surgeon is able to easily control a movement of the laser. For example, the surgeon must be able to easily direct a laser beam by steering the beam to a first position aimed at a first target, guide the laser beam from the first position to a second position aimed at a second target, and hold the laser beam in the second position. Accordingly, there is a need for a surgical laser probe that can be easily guided to a plurality of targets within the eye.

BRIEF SUMMARY OF THE INVENTION

The present disclosure presents a steerable laser probe. Illustratively, a steerable laser probe may comprise an actuation structure, a nosecone fixed to the actuation structure by one or more links and one or more link pins, a flexible housing tube, and an optic fiber disposed in the flexible housing tube and the actuation structure. In one or more embodiments, a compression of the actuation structure may be configured to gradually curve the flexible housing tube. Illustratively, a gradual curving of the flexible housing tube may be configured to gradually curve the optic fiber. In one or more embodiments, a decompression of the actuation structure may be configured to gradually straighten the flexible housing tube. Illustratively, a gradual straightening of the flexible housing tube may be configured to gradually curve the optic fiber.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and further advantages of the present invention may be better understood by referring to the following description in conjunction with the accompanying drawings in which like reference numerals indicate identical or functionally similar elements:

FIG. **1** is a schematic diagram illustrating an exploded view of a handle assembly;

FIGS. **2**A and **2**B are schematic diagrams illustrating a handle;

FIG. **3** is a schematic diagram illustrating a flexible housing tube;

FIG. **4** is a schematic diagram illustrating an exploded view of a steerable laser probe assembly;

FIGS. **5**A, **5**B, **5**C, **5**D, and **5**E are schematic diagrams illustrating a gradual curving of an optic fiber;

FIGS. **6**A, **6**B, **6**C, **6**D, and **6**E are schematic diagrams illustrating a gradual straightening of an optic fiber;

FIGS. **7**A and **7**B are schematic diagrams illustrating a handle;

FIG. **8** is a schematic diagram illustrating a flexible housing tube;

FIG. **9** is a schematic diagram illustrating an exploded view of a steerable laser probe assembly;

FIGS. **10**A, **10**B, **10**C, **10**D, and **10**E are schematic diagrams illustrating a gradual curving of an optic fiber;

FIGS. **11**A, **11**B, **11**C, **11**D, and **11**E are schematic diagrams illustrating a gradual straightening of an optic fiber.

DETAILED DESCRIPTION OF AN ILLUSTRATIVE EMBODIMENT

FIG. **1** is a schematic diagram illustrating an exploded view of a handle assembly **100**. Illustratively, a handle assembly **100** may comprise a nosecone **105** having a nosecone distal end **106** and a nosecone proximal end **107**, an actuation structure **110** having an actuation structure distal end **111** and an actuation structure proximal end **112**, a front plug **115**, a distal ring **116**, a proximal ring **117**, an outer sleeve **120** having an outer sleeve distal end **121** and an outer sleeve proximal end **122**, an actuation guide **130** having an actuation guide distal end **131** and an actuation guide proximal end **132**, an inner hypodermic tube **140** having an inner hypodermic tube distal end **141** and an inner hypodermic tube proximal end **142**, a piston **150** having a piston distal end **151** and a piston proximal end **152**, an end plug **160** having an end plug distal end **161** and an end plug proximal end **162**, one or more links **170**, one or more spacers **175**, and one or more link pins **180**. In one or more embodiments, nosecone **105**, actuation structure **110**, front plug **115**, outer sleeve **120**, actuation guide **130**, inner hypodermic tube **140**, piston **150**, and end plug **160** may be manufactured from any suitable material, e.g., polymers, metals, metal alloys, etc., or from any combination of suitable materials.

FIGS. **2**A and **2**B are schematic diagrams illustrating a handle **200**. FIG. **2**A illustrates a side view of a handle **200**. Illustratively, handle **200** may comprise a handle distal end **201** and a handle proximal end **202**. In one or more embodiments, a portion of nosecone **105** may be fixed to a portion of actuation structure **110**, e.g., nosecone proximal end **107** may be fixed to actuation structure distal end **111**. Illustratively, nosecone **105** may be fixed to actuation structure **110**, e.g., by one or more links **170**. In one or more embodiments, one or more link pins **180** may be configured to fix nosecone **105** to one or more links **170**, e.g., a particular link pin **180** may be disposed within nosecone **105** and a particular link **170**. Illustratively, one or more link pins **180** may be configured to fix actuation structure **110** to one or more links **170**, e.g., a particular link pin **180** may be disposed within actuation structure **110** and a particular link **170**. In one or more embodiments, a first link pin **180** may be configured to fix nosecone **105** to a particular link **170** and a second link pin **180** may be configured to fix actuation structure **110** to the particular link **175**. Illustratively, one or more spacers **175** may be configured to prevent undesirable movement of one or more links **170** relative to one or more link pins **180**, e.g., a particular spacer **175** may be disposed over a portion of a particular link pin **180** extending from a particular link **170**.

In one or more embodiments, a portion of inner hypodermic tube **140** may be disposed within piston **150**, e.g., inner hypodermic tube proximal end **142** may be disposed within piston **150**. Illustratively, a portion of inner hypodermic tube **140** may be fixed within piston **150**, e.g., by an adhesive or any suitable fixation means. In one or more embodiments, inner hypodermic tube proximal end **142** may be fixed within piston **150**, e.g., by an adhesive or any suitable fixation means. Illustratively, actuation guide **130** may be disposed within outer sleeve **120**. In one or more embodiments, actuation guide **130** may be fixed within outer sleeve **120**, e.g., by an adhesive or any suitable fixation means. Illustratively, piston **150** may be disposed within actuation guide **130**. In one or more embodiments, piston **150** may be configured to actuate within actuation guide **130**.

In one or more embodiments, distal ring **116** may be disposed over a portion of front plug **115**. Illustratively, front plug **115** may be configured to interface with a portion of outer sleeve **120**, e.g., front plug **115** may be configured to interface with outer sleeve distal end **121**. In one or more embodiments, front plug **115** may be configured to interface with a portion of actuation guide **130**, e.g., front plug **115** may be configured to interface with actuation guide distal end **131**. Illustratively, front plug **115** may be disposed within outer sleeve **120**. In one or more embodiments, a portion of front plug **115** may be disposed within actuation guide **130**. Illustratively, distal ring **116** may be disposed within actuation guide **130**, e.g., distal ring **116** may be configured to form a hermetic seal within actuation guide **130**.

In one or more embodiments, proximal ring **117** may be disposed over a portion of end plug **160**. Illustratively, end plug **160** may be configured to interface with a portion of outer sleeve **120**, e.g., end plug **160** may be configured to interface with outer sleeve proximal end **122**. In one or more embodiments, end plug **160** may be configured to interface with a portion of actuation guide **130**, e.g., end plug **160** may be configured to interface with actuation guide proximal end **132**. For example, a portion of end plug **160** may be disposed within actuation guide **130**. Illustratively, proximal ring **117** may be disposed within actuation guide **130**, e.g., proximal ring **117** may be configured to form a hermetic seal within actuation guide **130**. In one or more embodiments, end plug **160** may be disposed within outer sleeve **120**. Illustratively, inner hypodermic tube **140** may be disposed within piston **150**, actuation guide **130**, front plug **115**, distal ring **116**, and nosecone **105**. In one or more embodiments, a portion of inner hypodermic tube **140** may be fixed within nosecone **105**, e.g., inner hypodermic tube distal end **141** may be fixed within nosecone **105**. Illustratively, a portion of inner hypodermic tube **140** may be fixed within nosecone **105**, e.g., by an adhesive or any suitable fixation means.

In one or more embodiments, a compression of actuation structure **110** may be configured to rotate one or more links **170** about one or more link pins **180**. Illustratively, a rotation of one or more links **170** about one or more link pins **180** may be configured to extend a particular link pin **180**, e.g., a particular link pin **180** disposed in nosecone **105**, relative to handle proximal end **202**. In one or more embodiments, an extension of a particular link pin **180** disposed in nosecone **105** relative to handle proximal end **202** may be configured to extend nosecone **105** relative to handle proximal end **202**. Illustratively, a compression of actuation structure **110** may be configured to extend nosecone **105** relative to handle proximal end **202**. In one or more embodiments, an extension of nosecone **105** relative to handle proximal end **202** may be configured to extend inner hypodermic tube **140** relative to handle proximal end **202**. Illustratively, an extension of inner hypodermic tube **140** relative to handle proximal end **202** may be configured to actuate piston **150** within actuation guide **130**. In one or more embodiments, a compression of actuation structure **110** may be configured to extend piston **150** relative to handle proximal end **202**.

In one or more embodiments, a decompression of action structure **110** may be configured to rotate one or more links **170** about one or more link pins **180**. Illustratively, a rotation of one or more links **170** about one or more link pins **180** may be configured to retract a particular link pin **180**, e.g., a particular link pin **180** disposed in nosecone **105**, relative to handle proximal end **202**. In one or more embodiments, a retraction of a particular link pin **180** disposed in nosecone **105** relative to handle proximal end **202** may be configured to retract nosecone **105** relative to handle proximal end **202**. Illustratively, a decompression of actuation structure **110** may be configured to retract nosecone **105** relative to handle proximal end **202**. In one or more embodiments, a retraction of nosecone **105** relative to handle proximal end **202** may be configured to retract inner hypodermic tube **140** relative to handle proximal end **202**. Illustratively, a retraction of inner hypodermic tube **140** relative to handle proximal end **202** may be configured to actuate piston **150** within actuation guide **130**. In one or more embodiments, a decompression of actuation structure **110** may be configured to retract piston **150** relative to handle proximal end **202**.

FIG. **2**B illustrates a cross-sectional view of a handle **200**. In one or more embodiments, handle **200** may comprise an optic fiber housing **210**, an inner bore **220**, an optic fiber guide **230**, and a flexible housing tube housing **240**. Illustratively, handle **200** may be manufactured from any suitable material, e.g., polymers, metals, metal alloys, etc., or from any combination of suitable materials.

FIG. **3** is a schematic diagram illustrating a flexible housing tube **300**. Illustratively, flexible housing tube **300** may comprise a flexible housing tube distal end **301** and a flexible housing tube proximal end **302**. Flexible housing tube **300** may be manufactured from any suitable material, e.g., polymers, metals, metal alloys, etc., or from any combination of suitable materials. Illustratively, flexible housing tube **300** may comprise a shape memory material, e.g., Nitinol. In one or more embodiments, flexible housing tube **300** may be manufactured from a material having an ultimate tensile strength between 700 and 1000 MPa. Illustratively, flexible housing tube **300** may be manufactured from a material having ultimate tensile strength less than 700 MPa or greater than 1000 MPa. In one or more embodiments, flexible housing tube **300** may be manufactured from a material having a modulus of elasticity between 30 and 80 GPa. Illustratively, flexible housing tube **300** may be manufactured from a material having a modulus of elasticity less than 30 GPa or greater than 80 GPa.

In one or more embodiments, flexible housing tube **300** may be manufactured with dimensions suitable for performing microsurgical procedures, e.g., ophthalmic surgical procedures. Illustratively, flexible housing tube **300** may be manufactured at gauge sizes commonly used in ophthalmic surgical procedures, e.g., 23 gauge, 25 gauge, etc. In one or more embodiments, flexible housing tube **300** may be configured to be inserted in a cannula, e.g., a cannula used during an ophthalmic surgical procedure. For example, one or more properties of flexible housing tube **300** may be optimized to reduce friction as flexible housing tube **300** is inserted into a cannula. In one or more embodiments, one or more properties of flexible housing tube **300** may be optimized to reduce friction as flexible housing tube **300** is removed from a cannula. Illustratively, flexible housing tube **300** may have an ultimate tensile strength between 1000 MPa and 1100 MPa. In one or more embodiments, flexible housing tube **300** may have an ultimate tensile strength less than 1000 MPa or greater than 1100 MPa.

In one or more embodiments, an optic fiber **310** may be disposed within flexible housing tube **300**. Illustratively, optic fiber **310** may comprise an optic fiber distal end **311** and an optic fiber proximal end **312**. In one or more embodiments, optic fiber **310** may be configured to transmit light, e.g., laser light. Illustratively, optic fiber **310** may be disposed within flexible housing tube **300** wherein optic fiber distal end **311** may be adjacent to flexible housing tube distal end **301**. In one or more embodiments, a portion of optic fiber **310** may be fixed to a portion of flexible housing tube **300**, e.g., by an adhesive or any suitable fixation means.

FIG. **4** is a schematic diagram illustrating an exploded view of a steerable laser probe assembly **400**. Illustratively, a steerable laser probe assembly **400** may comprise a handle **200**, a flexible housing tube **300** having a flexible housing tube distal end **301** and a flexible housing tube proximal end **302**, an optic fiber **310** having an optic fiber distal end **311** and an optic fiber proximal end **312**, and a light source interface **410**. Illustratively, light source interface **410** may be configured to interface with optic fiber **310**, e.g., at optic fiber proximal end **312**. In one or more embodiments, light source interface **410** may comprise a standard light source connecter, e.g., an SMA connector.

Illustratively, a portion of flexible housing tube **300** may be fixed to nosecone **105**, e.g., flexible housing tube proximal end **302** may be fixed to nosecone distal end **106**. In one or more embodiments, a portion of flexible housing tube **300** may be fixed to nosecone **105**, e.g., by an adhesive or any suitable fixation means. Illustratively, a portion of flexible housing tube **300** may be disposed within nosecone **105**, e.g., flexible housing tube proximal end **302** may be disposed within nosecone **105**. In one or more embodiments, a portion of flexible housing tube **300** may be fixed within nosecone **105**, e.g., by an adhesive or any suitable fixation means. Illustratively, a portion of flexible housing tube **300** may be disposed within flexible housing tube housing **240**, e.g., flexible housing tube proximal end **302** may be disposed within flexible housing tube housing **240**. In one or more embodiments, a portion of flexible housing tube **300** may be fixed within flexible housing tube housing **240**, e.g., by an adhesive or any suitable fixation means. For example, a portion of flexible housing tube **300** may be fixed within flexible housing tube housing **240** by a press fit, a weld, etc.

Illustratively, optic fiber **310** may be disposed within inner bore **220**, optic fiber guide **230**, optic fiber housing **210**, piston **150**, inner hypodermic tube **140**, nosecone **105**, and flexible housing tube **300**. In one or more embodiments, optic fiber **310** may be disposed within flexible housing tube **300** wherein optic fiber distal end **311** is adjacent to flexible housing tube distal end **301**. In one or more embodiments, a portion of optic fiber **310** may be fixed to a portion of flexible housing tube **300**, e.g., by an adhesive or any suitable fixation means. Illustratively, a portion of optic fiber **310** may be fixed in a position relative to handle proximal end **202**. In one or more embodiments, optic fiber **310** may be fixed within optic fiber housing **210**, e.g., by an adhesive or any suitable fixation means. For example, optic fiber **310** may be fixed within optic fiber housing **210** by a press fit, a setscrew, etc. Illustratively, a first portion of optic fiber **310** may be fixed in optic fiber housing **210** and a second portion of optic fiber **310** may be fixed to a portion of flexible housing tube **300**.

In one or more embodiments, a compression of actuation structure **110** may be configured to rotate one or more links **170** about one or more link pins **180**. Illustratively, a rotation of one or more links **170** about one or more link pins **180** may be configured to extend nosecone **105** relative to handle proximal end **202**. In one or more embodiments, an extension of nosecone **105** relative to handle proximal end **202** may be configured to extend flexible housing tube **300** relative to handle proximal end **202**. Illustratively, an extension of flexible housing tube **300** relative to handle proximal end **202** may be configured to extend flexible housing tube **300** relative to optic fiber **310**. In one or more embodiments, a portion of optic fiber **310**, e.g., a portion of optic fiber **310** fixed to flexible housing tube **300**, may be configured to resist an extension of flexible housing tube **300** relative to optic fiber **310**. Illustratively, optic fiber **310** may be fixed within optic fiber housing **210** and optic fiber **310** may be fixed to flexible housing tube **300**. In one or more embodiments, an extension of flexible housing tube **300** relative to optic fiber **310** may be configured to apply a force to a portion of flexible housing tube **300**. Illustratively, an application of a force to a portion of flexible housing tube **300** may be configured to compress a portion of flexible housing tube **300**, e.g., an application of a force to a portion of flexible housing tube **300** may be configured to compress a portion of flexible housing tube **300**. In one or more embodiments, a compression of a portion of flexible housing tube **300** may be configured to cause flexible housing tube **300** to gradually curve. Illustratively, a gradual curving of flexible housing tube **300** may be configured to gradually curve optic fiber **310**. In one or more embodiments, a compression of actuation structure **110** may be configured to gradually curve optic fiber **310**. Illustratively, a compression of actuation structure **110** may be configured to gradually curve flexible housing tube **300**.

In one or more embodiments, a decompression of actuation structure **110** may be configured to rotate one or more links **170** about one or more link pins **180**. Illustratively, a rotation of one or more links **170** about one or more link pins **180** may be configured to retract nosecone **105** relative to handle proximal end **202**. In one or more embodiments, a refraction of nosecone **105** relative to handle proximal end **202** may be configured to retract flexible housing tube **300** relative to handle proximal end **202**. Illustratively, a retraction of flexible housing tube **300** relative to handle proximal end **202** may be configured to retract flexible housing tube **300** relative to optic fiber **310**. In one or more embodiments, a portion of optic fiber **310**, e.g., a portion of optic fiber **310** fixed to flexible housing tube **300**, may be configured to facilitate a retraction of flexible housing tube **300** relative to optic fiber **310**. Illustratively, optic fiber **310** may be fixed within optic fiber housing **210** and optic fiber **310** may be fixed to flexible housing tube **300**. In one or more embodiments, a retraction of flexible housing tube **300** relative to optic fiber **310** may be configured to reduce a force applied to a portion of flexible housing tube **300**. Illustratively, a reduction of a force applied to a portion of flexible housing tube **300** may be configured to decompress a portion of flexible housing tube **300**, e.g., a reduction of a force applied to a portion of flexible housing tube **300** may be configured to decompress a portion of flexible housing tube **300**. In one or more embodiments, a decompression of a portion of flexible housing tube **300** may be configured to cause flexible housing tube **300** to gradually straighten. Illustratively, a gradual straightening of flexible housing tube **300** may be configured to gradually straighten optic fiber **310**. In one or more embodiments, a decompression of actuation structure **110** may be configured to gradually straighten optic fiber **310**. Illustratively, a decompression of actuation structure **110** may be configured to gradually straighten flexible housing tube **300**.

FIGS. **5**A, **5**B, **5**C, **5**D, and **5**E are schematic diagrams illustrating a gradual curving of an optic fiber **310**. FIG. **5**A illustrates a straight optic fiber **500**. In one or more embodiments, optic fiber **310** may comprise a straight optic fiber **500**, e.g., when flexible housing tube **300** is fully retracted relative to optic fiber **310**. Illustratively, optic fiber **310** may comprise a straight optic fiber **500**, e.g., when actuation structure **110** is fully decompressed. In one or more embodiments, optic fiber **310** may comprise a straight optic fiber **500**, e.g., when nosecone **105** is fully retracted relative to handle proximal end **202**. Illustratively, a line tangent to optic fiber distal end **311** may be parallel to a line tangent to flexible housing tube proximal end **302**, e.g., when optic fiber **310** comprises a straight optic fiber **500**.

FIG. **5**B illustrates an optic fiber in a first curved position **510**. In one or more embodiments, a compression of actuation structure **110** may be configured to gradually curve optic fiber **310** from a straight optic fiber **500** to an optic fiber in a first curved position **510**. Illustratively, a compression of actuation structure **110** may be configured to rotate one or more links **170** about one or more link pins **180**. In one or more embodiments, a rotation of one or more links **170** about one or more link pins **180** may be configured to extend nosecone **105** relative to handle proximal end **202**. Illustratively, an extension of nosecone **105** relative to handle proximal end **202** may be configured to extend flexible housing tube **300** relative to optic fiber **310**. In one or more embodiments, an extension of flexible housing tube **300** relative to optic fiber **310** may be configured to apply a force to a portion of flexible housing tube **300**, e.g., a portion of optic fiber **310** fixed to flexible housing tube **300** may be configured to apply a force to flexible housing tube **300**. Illustratively, an application of a force to a portion of flexible housing tube **300** may be configured to compress a portion of flexible housing tube **300**. In one or more embodiments, a compression of a portion of flexible housing tube **300** may be configured to cause flexible housing tube **300** to gradually curve. Illustratively, a gradual curving of flexible housing tube **300** may be configured to gradually curve optic fiber **310**, e.g., from a straight optic fiber **500** to an optic fiber in a first curved position **510**. In one or more embodiments, a line tangent to optic fiber distal end **311** may intersect a line tangent to flexible housing tube proximal end **302** at a first angle, e.g., when optic fiber **310** comprises an optic fiber in a first curved position **510**. In one or more embodiments, the first angle may comprise any angle greater than zero degrees. For example, the first angle may comprise a 45 degree angle.

FIG. **5**C illustrates an optic fiber in a second curved position **520**. In one or more embodiments, a compression of actuation structure **110** may be configured to gradually curve optic fiber **310** from an optic fiber in a first curved position **510** to an optic fiber in a second curved position **520**. Illustratively, a compression of actuation structure **110** may be configured to rotate one or more links **170** about one or more link pins **180**. In one or more embodiments, a rotation of one or more links **170** about one or more link pins **180** may be configured to extend nosecone **105** relative to handle proximal end **202**. Illustratively, an extension of nosecone **105** relative to handle proximal end **202** may be configured to extend flexible housing tube **300** relative to optic fiber **310**. In one or more embodiments, an extension of flexible housing tube **300** relative to optic fiber **310** may be configured to apply a force to a portion of flexible housing tube **300**, e.g., a portion of optic fiber **310** fixed to flexible housing tube **300** may be configured to apply a force to flexible housing tube **300**. Illustratively, an application of a force to a portion of flexible housing tube **300** may be configured to compress a portion of flexible housing tube **300**. In one or more embodiments, a compression of a portion of flexible housing tube **300** may be configured to cause flexible housing tube **300** to gradually curve. Illustratively, a gradual curving of flexible housing tube **300** may be configured to gradually curve optic fiber **310**, e.g., from an optic fiber in a first curved position **510** to an optic fiber in a second curved position **520**. In one or more embodiments, a line tangent to optic fiber distal end **311** may intersect a line tangent to flexible housing tube proximal end **302** at a second angle, e.g., when optic fiber **310** comprises an optic fiber in a second curved position **520**. In one or more embodiments, the second angle may comprise any angle greater than the first angle. For example, the second angle may comprise a 90 degree angle.

FIG. **5**D illustrates an optic fiber in a third curved position **530**. In one or more embodiments, a compression of actuation structure **110** may be configured to gradually curve optic fiber **310** from an optic fiber in a second curved position **520** to an optic fiber in a third curved position **530**. Illustratively, a compression of actuation structure **110** may be configured to rotate one or more links **170** about one or more link pins **180**. In one or more embodiments, a rotation of one or more links **170** about one or more link pins **180** may be configured to extend nosecone **105** relative to handle proximal end **202**. Illustratively, an extension of nosecone **105** relative to handle proximal end **202** may be configured to extend flexible housing tube **300** relative to optic fiber **310**. In one or more embodiments, an extension of flexible housing tube **300** relative to optic fiber **310** may be configured to apply a force to a portion of flexible housing tube **300**, e.g., a portion of optic fiber **310** fixed to flexible housing tube **300** may be configured to apply a force to flexible housing tube **300**. Illustratively, an application of a force to a portion of flexible housing tube **300** may be configured to compress a portion of flexible housing tube **300**. In one or more embodiments, a compression of a portion of flexible housing tube **300** may be configured to cause flexible housing tube **300** to gradually curve. Illustratively, a gradual curving of flexible housing tube **300** may be configured to gradually curve optic fiber **310**, e.g., from an optic fiber in a second curved position **520** to an optic fiber in a third curved position **530**. In one or more embodiments, a line tangent to optic fiber distal end **311** may intersect a line tangent to flexible housing tube proximal end **302** at a third angle, e.g., when optic fiber **310** comprises an optic fiber in a third curved position **530**. In one or more embodiments, the third angle may comprise any angle greater than the second angle. For example, the third angle may comprise a 135 degree angle.

FIG. **5**E illustrates an optic fiber in a fourth curved position **540**. In one or more embodiments, a compression of actuation structure **110** may be configured to gradually curve optic fiber **310** from an optic fiber in a third curved position **530** to an optic fiber in a fourth curved position **540**. Illustratively, a compression of actuation structure **110** may be configured to rotate one or more links **170** about one or more link pins **180**. In one or more embodiments, a rotation of one or more links **170** about one or more link pins **180** may be configured to extend nosecone **105** relative to handle proximal end **202**. Illustratively, an extension of nosecone **105** relative to handle proximal end **202** may be configured to extend flexible housing tube **300** relative to optic fiber **310**. In one or more embodiments, an extension of flexible housing tube **300** relative to optic fiber **310** may be configured to apply a force to a portion of flexible housing tube **300**, e.g., a portion of optic fiber **310** fixed to flexible housing tube **300** may be configured to apply a force to flexible housing tube **300**. Illustratively, an application of a force to a portion of flexible housing tube **300** may be configured to compress a portion of flexible housing tube **300**. In one or more embodiments, a compression of a portion of flexible housing tube **300** may be configured to cause flexible housing tube **300** to gradually curve. Illustratively, a gradual curving of flexible housing tube **300** may be configured to gradually curve optic fiber **310**, e.g., from an optic fiber in a third curved position **530** to an optic fiber in a fourth curved position **540**. In one or more embodiments, a line tangent to optic fiber distal end **311** may be parallel to a line tangent to flexible housing tube proximal end **302**, e.g., when optic fiber **310** comprises an optic fiber in a fourth curved position **540**.

In one or more embodiments, one or more properties of a steerable laser probe may be adjusted to attain one or more desired steerable laser probe features. Illustratively, a length that flexible housing tube distal end **301** extends from nosecone distal end **106** may be adjusted to vary an amount of compression of actuation structure **110** configured to curve flexible housing tube **300** to a particular curved position. In one or more embodiments, a stiffness of flexible housing tube **300** may be adjusted to vary an amount of compression of actuation structure **110** configured to curve flexible housing tube **300** to a particular curved position. Illustratively, flexible housing tube **300** may comprise a solid tube structure. In one or more embodiments, flexible housing tube **300** may comprise one or more apertures, e.g., configured to vary a stiffness of flexible housing tube **300**. Illustratively, a material comprising flexible housing tube **300** may be adjusted to vary an amount of compression of actuation structure **110** configured to curve flexible housing tube **300** to a particular curved position. In one or more embodiments, a stiffness of flexible housing tube **300** may be adjusted to vary a bend radius of flexible housing tube **300**. Illustratively, a stiffness of flexible housing tube **300** may be adjusted to vary a radius of curvature of flexible housing tube **300**, e.g., when flexible housing tube **300** is in a particular curved position.

In one or more embodiments, at least a portion of optic fiber **310** may be enclosed in an optic fiber sleeve configured to, e.g., protect optic fiber **310**, vary a stiffness of optic fiber **310**, vary an optical property of optic fiber **310**, etc. Illustratively, an optic fiber sleeve may be configured to compress a portion of flexible housing tube **300**. For example, an optic fiber sleeve may be disposed over a portion of optic fiber **310** fixed within optic fiber housing **210** and the optic fiber sleeve may be disposed over a portion of optic fiber **310** fixed to a portion of flexible housing tube **300**. In one or more embodiments, a compression of actuation structure **110** may be configured to extend flexible housing tube **300** relative to the optic fiber sleeve. Illustratively, an extension of flexible housing tube **300** relative to the optic fiber sleeve may cause the optic fiber sleeve to apply a force to a portion of flexible housing tube **300**. Illustratively, an application of a force to a portion of flexible housing tube **300** may be configured to compress a portion of flexible housing tube **300** causing flexible housing tube **300** to gradually curve.

Illustratively, optic fiber **310** may comprise a buffer, a cladding disposed in the buffer, and a core disposed in the cladding. In one or more embodiments, at least a portion of optic fiber **310** may comprise a buffer configured to protect an optical property of optic fiber **310**. Illustratively, at least a portion of optic fiber **310** may comprise a buffer configured to protect an optical layer of optic fiber **310**, e.g., the buffer may protect an optical layer of a curved portion of optic fiber **310**. In one or more embodiments, at least a portion of optic fiber **310** may comprise a polyimide buffer configured to protect an optical property of optic fiber **310**. For example, at least a portion of optic fiber **310** may comprise a Kapton buffer configured to protect an optical property of optic fiber **310**.

Illustratively, a steerable laser probe may be configured to indicate, e.g., to a surgeon, a direction that optic fiber **310** may curve, e.g., due to a compression of actuation structure **110**. In one or more embodiments, a portion of a steerable laser probe, e.g., handle **200**, may be marked in a manner configured to indicate a direction that optic fiber **310** may curve. For example, a portion of flexible housing tube **300** may comprise a mark configured to indicate a direction that optic fiber **310** may curve. Illustratively, flexible housing tube **300** may comprise a slight curve, e.g., a curve less than 7.5 degrees, when actuation structure **110** is fully decompressed. In one or more embodiments, flexible housing tube **300** may comprise a slight curve configured to indicate a direction that optic fiber **310** may curve, e.g., due to a compression of actuation structure **110**.

Illustratively, a steerable laser probe may comprise an actuation structure **110**, a nosecone **105** fixed to actuation structure **110** by one or more links **170** and one or more link pins **180**, a flexible housing tube **300**, and an optic fiber **310**. In one or more embodiments, a compression of actuation structure **110** may be configured to extend nosecone **105** relative to actuation structure proximal end **112**. Illustratively, an extension of nosecone **105** relative to actuation structure proximal end **112** may be configured to extend flexible housing tube **300** relative to optic fiber **310**. In one or more embodiments, an extension of flexible housing tube **300** relative to optic fiber **310** may be configured to apply a force to flexible housing tube **300**. Illustratively an application of a force to flexible housing tube **300** may be configured to compress a portion of flexible housing tube **300**. In one or more embodiments, a compression of a portion of flexible housing tube **300** may cause flexible housing tube **300** to gradually curve. Illustratively, a gradual curving of flexible housing tube **300** may be configured to gradually curve optic fiber **310**.

FIGS. **6**A, **6**B, **6**C, **6**D, and **6**E are schematic diagrams illustrating a gradual straightening of an optic fiber **310**. FIG. **6**A illustrates a fully curved optic fiber **600**. In one or more embodiments, optic fiber **310** may comprise a fully curved optic fiber **600**, e.g., when flexible housing tube **300** is fully extended relative to optic fiber **310**. Illustratively, optic fiber **310** may comprise a fully curved optic fiber **600**, e.g., when actuation structure **110** is fully compressed. In one or more embodiments, optic fiber **310** may comprise a fully curved optic fiber **600**, e.g., when nosecone **105** is fully extended relative to handle proximal end **202**. Illustratively, a line tangent to optic fiber distal end **311** may be parallel to a line tangent to flexible housing tube proximal end **302**, e.g., when optic fiber **310** comprises a fully curved optic fiber **600**.

FIG. **6**B illustrates an optic fiber in a first partially straightened position **610**. In one or more embodiments, a decompression of actuation structure **110** may be configured to gradually straighten optic fiber **310** from a fully curved optic fiber **600** to an optic fiber in a first partially straightened position **610**. Illustratively, a decompression of actuation structure **110** may be configured to rotate one or more links **170** about one or more link pins **180**. In one or more embodiments, a rotation of one or more links **170** about one or more link pins **180** may be configured to retract nosecone **105** relative to handle proximal end **202**. Illustratively, a retraction of nosecone **105** relative to handle proximal end **202** may be configured to retract flexible housing tube **300** relative to optic fiber **310**. In one or more embodiments, a retraction of flexible housing tube **300** relative to optic fiber **310** may be configured to reduce a force applied to a portion of flexible housing tube **300**, e.g., a portion of optic fiber **310** fixed to flexible housing tube **300** may be configured to reduce a force applied to flexible housing tube **300**. Illustratively, a reduction of a force applied to a portion of flexible housing tube **300** may be configured to decompress a portion of flexible housing tube **300**. In one or more embodiments, a decompression of a portion of flexible housing tube **300** may be configured to cause flexible housing tube **300** to gradually straighten. Illustratively, a gradual straightening of flexible housing tube **300** may be configured to gradually straighten optic fiber **310**, e.g., from a fully curved optic fiber **600** to an optic fiber in a first partially straightened position **610**. In one or more embodiments, a line tangent to optic fiber distal end **311** may intersect a line tangent to flexible housing tube proximal end **302** at a first partially straightened angle, e.g., when optic fiber **310** comprises an optic fiber in a first partially straightened position **610**. Illustratively, the first partially straightened angle may comprise any angle less than 180 degrees. For example, the first partially straightened angle may comprise a 135 degree angle.

FIG. **6**C illustrates an optic fiber in a second partially straightened position **620**. In one or more embodiments, a decompression of actuation structure **110** may be configured to gradually straighten optic fiber **310** from an optic fiber in a first partially straightened position **610** to an optic fiber in a second partially straightened position **620**. Illustratively, a decompression of actuation structure **110** may be configured to rotate one or more links **170** about one or more link pins **180**. In one or more embodiments, a rotation of one or more links **170** about one or more link pins **180** may be configured to retract nosecone **105** relative to handle proximal end **202**. Illustratively, a retraction of nosecone **105** relative to handle proximal end **202** may be configured to retract flexible housing tube **300** relative to optic fiber **310**. In one or more embodiments, a retraction of flexible housing tube **300** relative to optic fiber **310** may be configured to reduce a force applied to a portion of flexible housing tube **300**, e.g., a portion of optic fiber **310** fixed to flexible housing tube **300** may be configured to reduce a force applied to flexible housing tube **300**. Illustratively, a reduction of a force applied to a portion of flexible housing tube **300** may be configured to decompress a portion of flexible housing tube **300**. In one or more embodiments, a decompression of a portion of flexible housing tube **300** may be configured to cause flexible housing tube **300** to gradually straighten. Illustratively, a gradual straightening of flexible housing tube **300** may be configured to gradually straighten optic fiber **310**, e.g., from an optic fiber in a first partially straightened position **610** to an optic fiber in a second partially straightened position **620**. In one or more embodiments, a line tangent to optic fiber distal end **311** may intersect a line tangent to flexible housing tube proximal end **302** at a second partially straightened angle, e.g., when optic fiber **310** comprises an optic fiber in a second partially straightened position **620**. Illustratively, the second partially straightened angle may comprise any angle less than the first partially straightened angle. For example, the second partially straightened angle may comprise a 90 degree angle.

FIG. **6**D illustrates an optic fiber in a third partially straightened position **630**. In one or more embodiments, a decompression of actuation structure **110** may be configured to gradually straighten optic fiber **310** from an optic fiber in a second partially straightened position **620** to an optic fiber in a third partially straightened position **630**. Illustratively, a decompression of actuation structure **110** may be configured to rotate one or more links **170** about one or more link pins **180**. In one or more embodiments, a rotation of one or more links **170** about one or more link pins **180** may be configured to retract nosecone **105** relative to handle proximal end **202**. Illustratively, a retraction of nosecone **105** relative to handle proximal end **202** may be configured to retract flexible housing tube **300** relative to optic fiber **310**. In one or more embodiments, a retraction of flexible housing tube **300** relative to optic fiber **310** may be configured to reduce a force applied to a portion of flexible housing tube **300**, e.g., a portion of optic fiber **310** fixed to flexible housing tube **300** may be configured to reduce a force applied to flexible housing tube **300**. Illustratively, a reduction of a force applied to a portion of flexible housing tube **300** may be configured to decompress a portion of flexible housing tube **300**. In one or more embodiments, a decompression of a portion of flexible housing tube **300** may be configured to cause flexible housing tube **300** to gradually straighten. Illustratively, a gradual straightening of flexible housing tube **300** may be configured to gradually straighten optic fiber **310**, e.g., from an optic fiber in a second partially straightened position **620** to an optic fiber in a third partially straightened position **630**. In one or more embodiments, a line tangent to optic fiber distal end **311** may intersect a line tangent to flexible housing tube proximal end **302** at a third partially straightened angle, e.g., when optic fiber **310** comprises an optic fiber in a third partially straightened position **630**. Illustratively, the third partially straightened angle may comprise any angle less than the second partially straightened angle. For example, the third partially straightened angle may comprise a 45 degree angle.

FIG. **6**E illustrates an optic fiber in a fully straightened position **640**. In one or more embodiments, a decompression of actuation structure **110** may be configured to gradually straighten optic fiber **310** from an optic fiber in a third partially straightened position **630** to an optic fiber in a fully straightened position **640**. Illustratively, a decompression of actuation structure **110** may be configured to rotate one or more links **170** about one or more link pins **180**. In one or more embodiments, a rotation of one or more links **170** about one or more link pins **180** may be configured to retract nosecone **105** relative to handle proximal end **202**. Illustratively, a retraction of nosecone **105** relative to handle proximal end **202** may be configured to retract flexible housing tube **300** relative to optic fiber **310**. In one or more embodiments, a retraction of flexible housing tube **300** relative to optic fiber **310** may be configured to reduce a force applied to a portion of flexible housing tube **300**, e.g., a portion of optic fiber **310** fixed to flexible housing tube **300** may be configured to reduce a force applied to flexible housing tube **300**. Illustratively, a reduction of a force applied to a portion of flexible housing tube **300** may be configured to decompress a portion of flexible housing tube **300**. In one or more embodiments, a decompression of a portion of flexible housing tube **300** may be configured to cause flexible housing tube **300** to gradually straighten. Illustratively, a gradual straightening of flexible housing tube **300** may be configured to gradually straighten optic fiber **310**, e.g., from an optic fiber in a third partially straightened position **630** to an optic fiber in a fully straightened position **640**. In one or more embodiments, a line tangent to optic fiber distal end **311** may be parallel to a line tangent to flexible housing tube proximal end **302**, e.g., when optic fiber **310** comprises an optic fiber in a fully straightened position **640**.

Illustratively, a surgeon may aim optic fiber distal end **311** at any of a plurality of targets within an eye, e.g., to perform a photocoagulation procedure, to illuminate a surgical target site, etc. For example, a surgeon may aim optic fiber distal end **311** at any of a plurality of targets within a human eye, e.g., to perform a photocoagulation procedure, to illuminate a surgical target site, etc. In one or more embodiments, a surgeon may aim optic fiber distal end **311** at any target within a particular transverse plane of the inner eye by, e.g., rotating handle **200** to orient flexible housing tube **300** in an orientation configured to cause a curvature of flexible housing tube **300** within the particular transverse plane of the inner eye and varying an amount of compression of actuation structure **110**. Illustratively, a surgeon may aim optic fiber distal end **311** at any target within a particular sagittal plane of the inner eye by, e.g., rotating handle **200** to orient flexible housing tube **300** in an orientation configured to cause a curvature of flexible housing tube **300** within the particular sagittal plane of the inner eye and varying an amount of compression of actuation structure **110**. In one or more embodiments, a surgeon may aim optic fiber distal end **311** at any target within a particular frontal plane of the inner eye by, e.g., varying an amount of actuation of compression of actuation structure **110** to orient a line tangent to optic fiber distal end **311** wherein the line tangent to optic fiber distal end **311** is within the particular frontal plane of the inner eye and rotating handle **200**. Illustratively, a surgeon may aim optic fiber distal end **311** at any target located outside of the particular transverse plane, the particular sagittal plane, and the particular frontal plane of the inner eye, e.g., by varying a rotational orientation of handle **200** and varying an amount of compression of actuation structure **110**. In one or more embodiments, a surgeon may aim optic fiber distal end **311** at any target of a plurality of targets within an eye, e.g., without increasing a length of a portion of a steerable laser probe within the eye. Illustratively, a surgeon may aim optic fiber distal end **311** at any target of a plurality of targets within an eye, e.g., without decreasing a length of a portion of a steerable laser probe within the eye.

FIGS. **7**A and **7**B are schematic diagrams illustrating a handle **700**. FIG. **7**A illustrates a side view of a handle **700**. Illustratively, handle **700** may comprise a handle distal end **701** and a handle proximal end **702**. In one or more embodiments, a portion of nosecone **105** may be fixed to a portion of actuation structure **110**, e.g., nosecone proximal end **107** may be fixed to actuation structure distal end **111**. Illustratively, nosecone **105** may be fixed to actuation structure **110**, e.g., by one or more links **170**. In one or more embodiments, one or more link pins **180** may be configured to fix nosecone **105** to one or more links **170**, e.g., a particular link pin **180** may be disposed within nosecone **105** and a particular link **170**. Illustratively, one or more link pins **180** may be configured to fix actuation structure **110** to one or more links **170**, e.g., a particular link pin **180** may be disposed within actuation structure **110** and a particular link **170**. In one or more embodiments, a first link pin **180** may be configured to fix nosecone **105** to a particular link **170** and a second link pin **180** may be configured to fix actuation structure **110** to the particular link **175**. Illustratively, one or more spacers **175** may be configured to prevent undesirable movement of one or more links **170** relative to one or more link pins **180**, e.g., a particular spacer **175** may be disposed over a portion of a particular link pin **180** extending from a particular link **170**.

In one or more embodiments, a portion of inner hypodermic tube **140** may be disposed within piston **150**, e.g., inner hypodermic tube proximal end **142** may be disposed within piston **150**. Illustratively, a portion of inner hypodermic tube **140** may be fixed within piston **150**, e.g., by an adhesive or any suitable fixation means. In one or more embodiments, inner hypodermic tube proximal end **142** may be fixed within piston **150**, e.g., by an adhesive or any suitable fixation means. Illustratively, actuation guide **130** may be disposed within outer sleeve **120**. In one or more embodiments, actuation guide **130** may be fixed within outer sleeve **120**, e.g., by an adhesive or any suitable fixation means. Illustratively, piston **150** may be disposed within actuation guide **130**. In one or more embodiments, piston **150** may be configured to actuate within actuation guide **130**.

In one or more embodiments, distal ring **116** may be disposed over a portion of front plug **115**. Illustratively, front plug **115** may be configured to interface with a portion of outer sleeve **120**, e.g., front plug **115** may be configured to interface with outer sleeve distal end **121**. In one or more embodiments, front plug **115** may be configured to interface with a portion of actuation guide **130**, e.g., front plug **115** may be configured to interface with actuation guide distal end **131**. Illustratively, front plug **115** may be disposed within outer sleeve **120**. In one or more embodiments, a portion of front plug **115** may be disposed within actuation guide **130**. Illustratively, distal ring **116** may be disposed within actuation guide **130**, e.g., distal ring **116** may be configured to form a hermetic seal within actuation guide **130**.

In one or more embodiments, proximal ring **117** may be disposed over a portion of end plug **160**. Illustratively, end plug **160** may be configured to interface with a portion of outer sleeve **120**, e.g., end plug **160** may be configured to interface with outer sleeve proximal end **122**. In one or more embodiments, end plug **160** may be configured to interface with a portion of actuation guide **130**, e.g., end plug **160** may be configured to interface with actuation guide proximal end **132**. For example, a portion of end plug **160** may be disposed within actuation guide **130**. Illustratively, proximal ring **117** may be disposed within actuation guide **130**, e.g., proximal ring **117** may be configured to form a hermetic seal within actuation guide **130**. In one or more embodiments, end plug **160** may be disposed within outer sleeve **120**. Illustratively, inner hypodermic tube **140** may be disposed within piston **150**, actuation guide **130**, front plug **115**, distal ring **116**, and nosecone **105**. In one or more embodiments, a portion of inner hypodermic tube **140** may be fixed within nosecone **105**, e.g., inner hypodermic tube distal end **141** may be fixed within nosecone **105**. Illustratively, a portion of inner hypodermic tube **140** may be fixed within nosecone **105**, e.g., by an adhesive or any suitable fixation means.

In one or more embodiments, a compression of actuation structure **110** may be configured to rotate one or more links **170** about one or more link pins **180**. Illustratively, a rotation of one or more links **170** about one or more link pins **180** may be configured to extend a particular link pin **180**, e.g., a particular link pin **180** disposed in nosecone **105**, relative to handle proximal end **702**. In one or more embodiments, an extension of a particular link pin **180** disposed in nosecone **105** relative to handle proximal end **702** may be configured to extend nosecone **105** relative to handle proximal end **702**. Illustratively, a compression of actuation structure **110** may be configured to extend nosecone **105** relative to handle proximal end **702**. In one or more embodiments, an extension of nosecone **105** relative to handle proximal end **702** may be configured to extend inner hypodermic tube **140** relative to handle proximal end **702**. Illustratively, an extension of inner hypodermic tube **140** relative to handle proximal end **702** may be configured to actuate piston **150** within actuation guide **130**. In one or more embodiments, a compression of actuation structure **110** may be configured to extend piston **150** relative to handle proximal end **702**.

In one or more embodiments, a decompression of action structure **110** may be configured to rotate one or more links **170** about one or more link pins **180**. Illustratively, a rotation of one or more links **170** about one or more link pins **180** may be configured to retract a particular link pin **180**, e.g., a particular link pin **180** disposed in nosecone **105**, relative to handle proximal end **702**. In one or more embodiments, a retraction of a particular link pin **180** disposed in nosecone **105** relative to handle proximal end **702** may be configured to retract nosecone **105** relative to handle proximal end **702**. Illustratively, a decompression of actuation structure **110** may be configured to retract nosecone **105** relative to handle proximal end **702**. In one or more embodiments, a retraction of nosecone **105** relative to handle proximal end **702** may be configured to retract inner hypodermic tube **140** relative to handle proximal end **702**. Illustratively, a retraction of inner hypodermic tube **140** relative to handle proximal end **702** may be configured to actuate piston **150** within actuation guide **130**. In one or more embodiments, a decompression of actuation structure **110** may be configured to retract piston **150** relative to handle proximal end **702**.

FIG. **7B** illustrates a cross-sectional view of a handle **700**. In one or more embodiments, handle **700** may comprise a cable housing **710**, an inner bore **220**, an optic fiber guide **230**, and a flexible housing tube housing **240**. Illustratively, handle **700** may be manufactured from any suitable material, e.g., polymers, metals, metal alloys, etc., or from any combination of suitable materials.

FIG. **8** is a schematic diagram illustrating a flexible housing tube **300**. Illustratively, flexible housing tube **300** may comprise a flexible housing tube distal end **301** and a flexible housing tube proximal end **302**. Flexible housing tube **300** may be manufactured from any suitable material, e.g., polymers, metals, metal alloys, etc., or from any combination of suitable materials. Illustratively, flexible housing tube **300** may comprise a shape memory material, e.g., Nitinol. In one or more embodiments, flexible housing tube **300** may be manufactured from a material having an ultimate tensile strength between 700 and 1000 MPa. Illustratively, flexible housing tube **300** may be manufactured from a material having ultimate tensile strength less than 700 MPa or greater than 1000 MPa. In one or more embodiments, flexible housing tube **300** may be manufactured from a material having a modulus of elasticity between 30 and 80 GPa. Illustratively, flexible housing tube **300** may be manufactured from a material having a modulus of elasticity less than 30 GPa or greater than 80 GPa.

In one or more embodiments, flexible housing tube **300** may be manufactured with dimensions suitable for performing microsurgical procedures, e.g., ophthalmic surgical procedures. Illustratively, flexible housing tube **300** may be manufactured at gauge sizes commonly used in ophthalmic surgical procedures, e.g., 23 gauge, 25 gauge, etc. In one or more embodiments, flexible housing tube **300** may be configured to be inserted in a cannula, e.g., a cannula used during an ophthalmic surgical procedure. For example, one or more properties of flexible housing tube **300** may be optimized to reduce friction as flexible housing tube **300** is inserted into a cannula. In one or more embodiments, one or more properties of flexible housing tube **300** may be optimized to reduce friction as flexible housing tube **300** is removed from a cannula. Illustratively, flexible housing tube **300** may have an ultimate tensile strength between 1000 MPa and 1100 MPa. In one or more embodiments, flexible housing tube **300** may have an ultimate tensile strength less than 1000 MPa or greater than 1100 MPa.

In one or more embodiments, an optic fiber **310** may be disposed within flexible housing tube **300**. Illustratively, optic fiber **310** may comprise an optic fiber distal end **311** and an optic fiber proximal end **312**. In one or more embodiments, optic fiber **310** may be configured to transmit light, e.g., laser light. Illustratively, optic fiber **310** may be disposed within flexible housing tube **300** wherein optic fiber distal end **311** may be adjacent to flexible housing tube distal end **301**. In one or more embodiments, a portion of optic fiber **310** may be fixed to a portion of flexible housing tube **300**, e.g., by an adhesive or any suitable fixation means.

Illustratively, a cable **810** may be disposed within flexible housing tube **300**. In one or more embodiments, cable **810** may comprise a cable distal end **811** and a cable proximal end **812**. Illustratively, cable **810** may be disposed within flexible housing tube **300** wherein cable distal end **811** may be adjacent to flexible housing tube distal end **301**. In one or more embodiments, a portion of cable **810** may be fixed to a portion of flexible housing tube **300**, e.g., by an adhesive or any suitable fixation means. For example, cable **810** may be fixed to a portion of flexible housing tube **300** by a weld, a mechanical means, a tie, etc.

FIG. **9** is a schematic diagram illustrating an exploded view of a steerable laser probe assembly **900**. Illustratively, a steerable laser probe assembly **900** may comprise a handle **700**, a flexible housing tube **300** having a flexible housing tube distal end **301** and a flexible housing tube proximal end **302**, an optic fiber **310** having an optic fiber distal end **311** and an optic fiber proximal end **312**, a cable **810** having a cable distal end **811** and a cable proximal end **812**, and a light source interface **410**. Illustratively, light source interface **410** may be configured to interface with optic fiber **310**, e.g., at optic fiber proximal end **312**. In one or more embodiments, light source interface **410** may comprise a standard light source connecter, e.g., an SMA connector.

Illustratively, a portion of flexible housing tube **300** may be fixed to nosecone **105**, e.g., flexible housing tube proximal end **302** may be fixed to nosecone distal end **106**. In one or more embodiments, a portion of flexible housing tube **300** may be fixed to nosecone **105**, e.g., by an adhesive or any suitable fixation means. Illustratively, a portion of flexible housing tube **300** may be disposed within nosecone **105**, e.g., flexible housing tube proximal end **302** may be disposed within nosecone **105**. In one or more embodiments, a portion of flexible housing tube **300** may be fixed within nosecone **105**, e.g., by an adhesive or any suitable fixation means. Illustratively, a portion of flexible housing tube **300** may be disposed within flexible housing tube housing **240**, e.g., flexible housing tube proximal end **302** may be disposed within flexible housing tube housing **240**. In one or more embodiments, a portion of flexible housing tube **300** may be fixed within flexible housing tube housing **240**, e.g., by an adhesive or any suitable fixation means. For example, a portion of flexible housing tube **300** may be fixed within flexible housing tube housing **240** by a press fit, a weld, etc.

Illustratively, optic fiber **310** may be disposed within inner bore **220**, optic fiber guide **230**, piston **150**, inner hypodermic tube **140**, nosecone **105**, and flexible housing tube **300**. In one or more embodiments, optic fiber **310** may be disposed within flexible housing tube **300** wherein optic fiber distal end **311** is adjacent to flexible housing tube distal end **301**. In one or more embodiments, a portion of optic fiber **310** may be fixed to a portion of flexible housing tube **300**, e.g., by an adhesive or any suitable fixation means.

Illustratively, cable **810** may be disposed within cable housing **710**, optic fiber guide **230**, piston **150**, inner hypodermic tube **140**, nosecone **105**, and flexible housing tube **300**. In one or more embodiment, cable **810** may be disposed within flexible housing tube **300** wherein cable distal end **811** may be adjacent to flexible housing tube distal end **301**. In one or more embodiments, a portion of cable **810** may be fixed to a portion of flexible housing tube **300**, e.g., by an adhesive or any suitable fixation means. For example, cable **810** may be fixed to a portion of flexible housing tube **300** by a weld, a mechanical means, a tie, etc. Illustratively, a portion of cable **810** may be fixed in cable housing **710**, e.g., cable proximal end **812** may be fixed in cable housing **710**. In one or more embodiments, a portion of cable **810** may be fixed in cable housing **710**, e.g., by an adhesive or any suitable fixation means. For example, a portion of cable **810** may be fixed in cable housing **710** by a press fit, a weld, a tie, etc. Illustratively, cable **810** may be fixed in cable housing **710** and cable **810** may be fixed to a portion of flexible housing tube **300**. Cable **810** may be manufactured from any suitable material, e.g., polymers, metals, metal alloys, etc., or from any combination of suitable materials.

In one or more embodiments, a compression of actuation structure **110** may be configured to rotate one or more links **170** about one or more link pins **180**. Illustratively, a rotation of one or more links **170** about one or more link pins **180** may be configured to extend nosecone **105** relative to handle proximal end **702**. In one or more embodiments, an extension of nosecone **105** relative to handle proximal end **702** may be configured to extend flexible housing tube **300** relative to handle proximal end **702**. Illustratively, an extension of flexible housing tube **300** relative to handle proximal end **702** may be configured to extend flexible housing tube **300** relative to cable **810**. In one or more embodiments, a portion of cable **810**, e.g., a portion of cable **810** fixed to flexible housing tube **300**, may be configured to resist an extension of flexible housing tube **300** relative to cable **810**. Illustratively, cable **810** may be fixed within cable housing **710** and cable **810** may be fixed to flexible housing tube **300**. In one or more embodiments, an extension of flexible housing tube **300** relative to cable **810** may be configured to apply a force to a portion of flexible housing tube **300**. Illustratively, an application of a force to a portion of flexible housing tube **300** may be configured to compress a portion of flexible housing tube **300**. In one or more embodiments, a compression of a portion of flexible housing tube **300** may be configured to cause flexible housing tube **300** to gradually curve. Illustratively, a gradual curving of flexible housing tube **300** may be configured to gradually curve optic fiber **310**. In one or more embodiments, a compression of actuation structure **110** may be configured to gradually curve optic fiber **310**. Illustratively, a compression of actuation structure **110** may be configured to gradually curve flexible housing tube **300**.

In one or more embodiments, a decompression of actuation structure **110** may be configured to rotate one or more links **170** about one or more link pins **180**. Illustratively, a rotation of one or more links **170** about one or more link pins **180** may be configured to retract nosecone **105** relative to handle proximal end **702**. In one or more embodiments, a refraction of nosecone **105** relative to handle proximal end **702** may be configured to retract flexible housing tube **300** relative to handle proximal end **702**. Illustratively, a retraction of flexible housing tube **300** relative to handle proximal end **702** may be configured to retract flexible housing tube **300** relative to cable **810**. In one or more embodiments, a portion of cable **810**, e.g., a portion of cable **810** fixed to flexible housing tube **300**, may be configured to facilitate a retraction of flexible housing tube **300** relative to cable **810**. Illustratively, cable **810** may be fixed within cable housing **710** and cable **810** may be fixed to flexible housing tube **300**. In one or more embodiments, a retraction of flexible housing tube **300** relative to cable **810** may be configured to reduce a force applied to a portion of flexible housing tube **300**. Illustratively, a reduction of a force applied to a portion of flexible housing tube **300** may be configured to decompress a portion of flexible housing tube **300**. In one or more embodiments, a decompression of a portion of flexible housing tube **300** may be configured to cause flexible housing tube **300** to gradually straighten. Illustratively, a gradual straightening of flexible housing tube **300** may be configured to gradually straighten optic fiber **310**. In one or more embodiments, a decompression of actuation structure **110** may be configured to gradually straighten optic fiber **310**. Illustratively, a decompression of actuation structure **110** may be configured to gradually straighten flexible housing tube **300**.

FIGS. **10**A, **10**B, **10**C, **10**D, and **10**E are schematic diagrams illustrating a gradual curving of an optic fiber **310**. FIG. **10**A illustrates a straight optic fiber **1000**. In one or more embodiments, optic fiber **310** may comprise a straight optic fiber **1000**, e.g., when flexible housing tube **300** is fully retracted relative to cable **810**. Illustratively, optic fiber **310** may comprise a straight optic fiber **1000**, e.g., when actuation structure **110** is fully decompressed. In one or more embodiments, optic fiber **310** may comprise a straight optic fiber **1000**, e.g., when nosecone **105** is fully retracted relative to handle proximal end **702**. Illustratively, a line tangent to optic fiber distal end **311** may be parallel to a line tangent to flexible housing tube proximal end **302**, e.g., when optic fiber **310** comprises a straight optic fiber **1000**.

FIG. **10**B illustrates an optic fiber in a first curved position **1010**. In one or more embodiments, a compression of actuation structure **110** may be configured to gradually curve optic fiber **310** from a straight optic fiber **1000** to an optic fiber in a first curved position **1010**. Illustratively, a compression of actuation structure **110** may be configured to rotate one or more links **170** about one or more link pins **180**. In one or more embodiments, a rotation of one or more links **170** about one or more link pins **180** may be configured to extend nosecone **105** relative to handle proximal end **702**. Illustratively, an extension of nosecone **105** relative to handle proximal end **702** may be configured to extend flexible housing tube **300** relative to cable **810**. In one or more embodiments, an extension of flexible housing tube **300** relative to cable **810** may be configured to apply a force to a portion of flexible housing tube **300**, e.g., a portion of cable **810** fixed to flexible housing tube **300** may be configured to apply a force to flexible housing tube **300**. Illustratively, an application of a force to a portion of flexible housing tube **300** may be configured to compress a portion of flexible housing tube **300**. In one or more embodiments, a compression of a portion of flexible housing tube **300** may be configured to cause flexible housing tube **300** to gradually curve. Illustratively, a gradual curving of flexible housing tube **300** may be configured to gradually curve optic fiber **310**, e.g., from a straight optic fiber **1000** to an optic fiber in a first curved position **1010**. In one or more embodiments, a line tangent to optic fiber distal end **311** may intersect a line tangent to flexible housing tube proximal end **302** at a first angle, e.g., when optic fiber **310** comprises an optic fiber in a first curved position **1010**. In one or more embodiments, the first angle may comprise any angle greater than zero degrees. For example, the first angle may comprise a 45 degree angle.

FIG. **10**C illustrates an optic fiber in a second curved position **1020**. In one or more embodiments, a compression of actuation structure **110** may be configured to gradually curve optic fiber **310** from an optic fiber in a first curved position **1010** to an optic fiber in a second curved position **1020**. Illustratively, a compression of actuation structure **110** may be configured to rotate one or more links **170** about one or more link pins **180**. In one or more embodiments, a rotation of one or more links **170** about one or more link pins **180** may be configured to extend nosecone **105** relative to handle proximal end **702**. Illustratively, an extension of nosecone **105** relative to handle proximal end **702** may be configured to extend flexible housing tube **300** relative to cable **810**. In one or more embodiments, an extension of flexible housing tube **300** relative to cable **810** may be configured to apply a force to a portion of flexible housing tube **300**, e.g., a portion of cable **810** fixed to flexible housing tube **300** may be configured to apply a force to flexible housing tube **300**. Illustratively, an application of a force to a portion of flexible housing tube **300** may be configured to compress a portion of flexible housing tube **300**. In one or more embodiments, a compression of a portion of flexible housing tube **300** may be configured to cause flexible housing tube **300** to gradually curve. Illustratively, a gradual curving of flexible housing tube **300** may be configured to gradually curve optic fiber **310**, e.g., from an optic fiber in a first curved position **1010** to an optic fiber in a second curved position **1020**. In one or more embodiments, a line tangent to optic fiber distal end **311** may intersect a line tangent to flexible housing tube proximal end **302** at a second angle, e.g., when optic fiber **310** comprises an optic fiber in a second curved position **1020**. In one or more embodiments, the second angle may comprise any angle greater than the first angle. For example, the second angle may comprise a 90 degree angle.

FIG. **10**D illustrates an optic fiber in a third curved position **1030**. In one or more embodiments, a compression of actuation structure **110** may be configured to gradually curve optic fiber **310** from an optic fiber in a second curved position **1020** to an optic fiber in a third curved position **1030**. Illustratively, a compression of actuation structure **110** may be configured to rotate one or more links **170** about one or more link pins **180**. In one or more embodiments, a rotation of one or more links **170** about one or more link pins **180** may be configured to extend nosecone **105** relative to handle proximal end **702**. Illustratively, an extension of nosecone **105** relative to handle proximal end **702** may be configured to extend flexible housing tube **300** relative to cable **810**. In one or more embodiments, an extension of flexible housing tube **300** relative to cable **810** may be configured to apply a force to a portion of flexible housing tube **300**, e.g., a portion of cable **810** fixed to flexible housing tube **300** may be configured to apply a force to flexible housing tube **300**. Illustratively, an application of a force to a portion of flexible housing tube **300** may be configured to compress a portion of flexible housing tube **300**. In one or more embodiments, a compression of a portion of flexible housing tube **300** may be configured to cause flexible housing tube **300** to gradually curve. Illustratively, a gradual curving of flexible housing tube **300** may be configured to gradually curve optic fiber **310**, e.g., from an optic fiber in a second curved position **1020** to an optic fiber in a third curved position **1030**. In one or more embodiments, a line tangent to optic fiber distal end **311** may intersect a line tangent to flexible housing tube proximal end **302** at a third angle, e.g., when optic fiber **310** comprises an optic fiber in a third curved position **1030**. In one or more embodiments, the third angle may comprise any angle greater than the second angle. For example, the third angle may comprise a 135 degree angle.

FIG. **10**E illustrates an optic fiber in a fourth curved position **1040**. In one or more embodiments, a compression of actuation structure **110** may be configured to gradually curve optic fiber **310** from an optic fiber in a third curved position **1030** to an optic fiber in a fourth curved position **1040**. Illustratively, a compression of actuation structure **110** may be configured to rotate one or more links **170** about one or more link pins **180**. In one or more embodiments, a rotation of one or more links **170** about one or more link pins **180** may be configured to extend nosecone **105** relative to handle proximal end **702**. Illustratively, an extension of nosecone **105** relative to handle proximal end **702** may be configured to extend flexible housing tube **300** relative to cable **810**. In one or more embodiments, an extension of flexible housing tube **300** relative to cable **810** may be configured to apply a force to a portion of flexible housing tube **300**, e.g., a portion of cable **810** fixed to flexible housing tube **300** may be configured to apply a force to flexible housing tube **300**. Illustratively, an application of a force to a portion of flexible housing tube **300** may be configured to compress a portion of flexible housing tube **300**. In one or more embodiments, a compression of a portion of flexible housing tube **300** may be configured to cause flexible housing tube **300** to gradually curve. Illustratively, a gradual curving of flexible housing tube **300** may be configured to gradually curve optic fiber **310**, e.g., from an optic fiber in a third curved position **1030** to an optic fiber in a fourth curved position **1040**. In one or more embodiments, a line tangent to optic fiber distal end **311** may be parallel to a line tangent to flexible housing tube proximal end **302**, e.g., when optic fiber **310** comprises an optic fiber in a fourth curved position **1040**.

In one or more embodiments, one or more properties of a steerable laser probe may be adjusted to attain one or more desired steerable laser probe features. Illustratively, a length that flexible housing tube distal end **301** extends from nosecone distal end **106** may be adjusted to vary an amount of compression of actuation structure **110** configured to curve flexible housing tube **300** to a particular curved position. In one or more embodiments, a stiffness of flexible housing tube **300** may be adjusted to vary an amount of compression of actuation structure **110** configured to curve flexible housing tube **300** to a particular curved position. Illustratively, flexible housing tube **300** may comprise a solid tube structure. In one or more embodiments, flexible housing tube **300** may comprise one or more apertures, e.g., configured to vary a stiffness of flexible housing tube **300**. Illustratively, a material comprising flexible housing tube **300** may be adjusted to vary an amount of compression of actuation structure **110** configured to curve flexible housing tube **300** to a particular curved position. In one or more embodiments, a stiffness of flexible housing tube **300** may be adjusted to vary a bend radius of flexible housing tube **300**. Illustratively, a stiffness of flexible housing tube **300** may be adjusted to vary a radius of curvature of flexible housing tube **300**, e.g., when flexible housing tube **300** is in a particular curved position.

In one or more embodiments, at least a portion of optic fiber **310** may be enclosed in an optic fiber sleeve configured to, e.g., protect optic fiber **310**, vary a stiffness of optic fiber **310**, vary an optical property of optic fiber **310**, etc. Illustratively, optic fiber **310** may comprise a buffer, a cladding disposed in the buffer, and a core disposed in the cladding. In one or more embodiments, at least a portion of optic fiber **310** may comprise a buffer configured to protect an optical property of optic fiber **310**. Illustratively, at least a portion of optic fiber **310** may comprise a buffer configured to protect an optical layer of optic fiber **310**, e.g., the buffer may protect an optical layer of a curved portion of optic fiber **310**. In one or more embodiments, at least a portion of optic fiber **310** may comprise a polyimide buffer configured to protect an optical property of optic fiber **310**. For example, at least a portion of optic fiber **310** may comprise a Kapton buffer configured to protect an optical property of optic fiber **310**.

In one or more embodiments, a location wherein cable **810** may be fixed to flexible housing tube **300** may be adjusted to vary an amount of compression of actuation structure **110** configured to curve flexible housing tube **300** to a particular curved position. For example, a portion of cable **810** may be fixed to an outer portion of flexible housing tube **300**. Illustratively, cable **810** may be fixed to flexible housing tube **300** at a plurality of fixation points, e.g., to vary one or more properties of a steerable laser probe. In one or more embodiments, a length of cable **810** may be adjusted to vary an amount of compression of actuation structure **110** configured to curve flexible housing tube **300** to a particular curved position. Illustratively, a steerable laser probe may comprise one or more redundant cables **810**. In one or more embodiments, one or more redundant cables **810** may be configured to maintain a particular curved position of flexible housing tube **300**, e.g., in the event that cable **810** breaks or fails. Illustratively, one or more redundant cables **810** may be configured to maintain a particular curved position of flexible housing tube **300**, e.g., in the event that a cable **810** fixation means fails. In one or more embodiments, one or more redundant cables **810** may be configured to maintain a particular curved position of flexible housing tube **300**, e.g., in the event that cable **810** is no longer configured to maintain the particular curved position of flexible housing tube **300**. Illustratively, one or more redundant cables **810** may be configured to maintain a particular curved position of flexible housing tube **300** wherein cable **810** is also configured to maintain the particular curved position of flexible housing tube **300**.

In one or more embodiments, flexible housing tube **300** may comprise an access window configured to allow access to a portion cable **810**. Illustratively, cable **810** may be fixed to a portion of flexible housing tube **300**, e.g., by looping a portion of cable **810** through an aperture in flexible housing tube **300**. In one or more embodiments, cable **810** may be fixed to a portion of flexible housing tube **300**, e.g., by a purely mechanical means. For example, cable **810** may be fixed to a portion of flexible housing tube **300** in a manner other than by an adhesive, a weld, etc. Illustratively, cable **810** may be fixed to a portion of flexible housing tube **300** wherein a portion of cable **810** is configured to fail at a first applied failure force and a fixation means that fixes a portion of cable **810** to a portion of flexible housing tube **300** is configured to fail at a second applied failure force. In one or more embodiments, the second applied failure force may be greater than the first applied failure force.

Illustratively, a steerable laser probe may be configured to indicate, e.g., to a surgeon, a direction that optic fiber **310** may curve, e.g., due to a compression of actuation structure **110**. In one or more embodiments, a portion of a steerable laser probe, e.g., handle **700**, may be marked in a manner configured to indicate a direction that optic fiber **310** may curve. For example, a portion of flexible housing tube **300** may comprise a mark configured to indicate a direction that optic fiber **310** may curve. Illustratively, flexible housing tube **300** may comprise a slight curve, e.g., a curve less than 7.5 degrees, when actuation structure **110** is fully decompressed. In one or more embodiments, flexible housing tube **300** may comprise a slight curve configured to indicate a direction that optic fiber **310** may curve, e.g., due to a compression of actuation structure **110**.

Illustratively, a steerable laser probe may comprise an actuation structure **110**, a nosecone **105** fixed to actuation structure **110** by one or more links **170** and one or more link pins **180**, a flexible housing tube **300**, an optic fiber **310**, and a cable **810**. In one or more embodiments, a compression of actuation structure **110** may be configured to extend nosecone **105** relative to actuation structure proximal end **112**. Illustratively, an extension of nosecone **105** relative to actuation structure proximal end **112** may be configured to extend flexible housing tube **300** relative to cable **810**. In one or more embodiments, an extension of flexible housing tube **300** relative to cable **810** may be configured to apply a force to flexible housing tube **300**. Illustratively an application of a force to flexible housing tube **300** may be configured to compress a portion of flexible housing tube **300**. In one or more embodiments, a compression of a portion of flexible housing tube **300** may cause flexible housing tube **300** to gradually curve. Illustratively, a gradual curving of flexible housing tube **300** may be configured to gradually curve optic fiber **310**.

FIGS. **11**A, **11**B, **11**C, **11**D, and **11**E are schematic diagrams illustrating a gradual straightening of an optic fiber **310**. FIG. **11**A illustrates a fully curved optic fiber **1100**. In one or more embodiments, optic fiber **310** may comprise a fully curved optic fiber **1100**, e.g., when flexible housing tube **300** is fully extended relative to cable **810**. Illustratively, optic fiber **310** may comprise a fully curved optic fiber **1100**, e.g., when actuation structure **110** is fully compressed. In one or more embodiments, optic fiber **310** may comprise a fully curved optic fiber **1100**, e.g., when nosecone **105** is fully extended relative to handle proximal end **702**. Illustratively, a line tangent to optic fiber distal end **311** may be parallel to a line tangent to flexible housing tube proximal end **302**, e.g., when optic fiber **310** comprises a fully curved optic fiber **1100**.

FIG. **11**B illustrates an optic fiber in a first partially straightened position **1110**. In one or more embodiments, a decompression of actuation structure **110** may be configured to gradually straighten optic fiber **310** from a fully curved optic fiber **1100** to an optic fiber in a first partially straightened position **1110**. Illustratively, a decompression of actuation structure **110** may be configured to rotate one or more links **170** about one or more link pins **180**. In one or more embodiments, a rotation of one or more links **170** about one or more link pins **180** may be configured to retract nosecone **105** relative to handle proximal end **702**. Illustratively, a retraction of nosecone **105** relative to handle proximal end **702** may be configured to retract flexible housing tube **300** relative to cable **810**. In one or more embodiments, a retraction of flexible housing tube **300** relative to cable **810** may be configured to reduce a force applied to a portion of flexible housing tube **300**, e.g., a portion of cable **810** fixed to flexible housing tube **300** may be configured to reduce a force applied to flexible housing tube **300**. Illustratively, a reduction of a force applied to a portion of flexible housing tube **300** may be configured to decompress a portion of flexible housing tube **300**. In one or more embodiments, a decompression of a portion of flexible housing tube **300** may be configured to cause flexible housing tube **300** to gradually straighten. Illustratively, a gradual straightening of flexible housing tube **300** may be configured to gradually straighten optic fiber **310**, e.g., from a fully curved optic fiber **1100** to an optic fiber in a first partially straightened position **1110**. In one or more embodiments, a line tangent to optic fiber distal end **311** may intersect a line tangent to flexible housing tube proximal end **302** at a first partially straightened angle, e.g., when optic fiber **310** comprises an optic fiber in a first partially straightened position **1110**. Illustratively, the first partially straightened angle may comprise any angle less than 180 degrees. For example, the first partially straightened angle may comprise a 135 degree angle.

FIG. **11**C illustrates an optic fiber in a second partially straightened position **1120**. In one or more embodiments, a decompression of actuation structure **110** may be configured to gradually straighten optic fiber **310** from an optic fiber in a first partially straightened position **1110** to an optic fiber in a second partially straightened position **1120**. Illustratively, a decompression of actuation structure **110** may be configured to rotate one or more links **170** about one or more link pins **180**. In one or more embodiments, a rotation of one or more links **170** about one or more link pins **180** may be configured to retract nosecone **105** relative to handle proximal end **702**. Illustratively, a retraction of nosecone **105** relative to handle proximal end **702** may be configured to retract flexible housing tube **300** relative to cable **810**. In one or more embodiments, a retraction of flexible housing tube **300** relative to cable **810** may be configured to reduce a force applied to a portion of flexible housing tube **300**, e.g., a portion of cable **810** fixed to flexible housing tube **300** may be configured to reduce a force applied to flexible housing tube **300**. Illustratively, a reduction of a force applied to a portion of flexible housing tube **300** may be configured to decompress a portion of flexible housing tube **300**. In one or more embodiments, a decompression of a portion of flexible housing tube **300** may be configured to cause flexible housing tube **300** to gradually straighten. Illustratively, a gradual straightening of flexible housing tube **300** may be configured to gradually straighten optic fiber **310**, e.g., from an optic fiber in a first partially straightened position **1110** to an optic fiber in a second partially straightened position **1120**. In one or more embodiments, a line tangent to optic fiber distal end **311** may intersect a line tangent to flexible housing tube proximal end **302** at a second partially straightened angle, e.g., when optic fiber **310** comprises an optic fiber in a second partially straightened position **1120**. Illustratively, the second partially straightened angle may comprise any angle less than the first partially straightened angle. For example, the second partially straightened angle may comprise a 90 degree angle.

FIG. **11**D illustrates an optic fiber in a third partially straightened position **1130**. In one or more embodiments, a decompression of actuation structure **110** may be configured to gradually straighten optic fiber **310** from an optic fiber in a second partially straightened position **1120** to an optic fiber in a third partially straightened position **1130**. Illustratively, a decompression of actuation structure **110** may be configured to rotate one or more links **170** about one or more link pins **180**. In one or more embodiments, a rotation of one or more links **170** about one or more link pins **180** may be configured to retract nosecone **105** relative to handle proximal end **702**. Illustratively, a retraction of nosecone **105** relative to handle proximal end **702** may be configured to retract flexible housing tube **300** relative to cable **810**. In one or more embodiments, a retraction of flexible housing tube **300** relative to cable **810** may be configured to reduce a force applied to a portion of flexible housing tube **300**, e.g., a portion of cable **810** fixed to flexible housing tube **300** may be configured to reduce a force applied to flexible housing tube **300**. Illustratively, a reduction of a force applied to a portion of flexible housing tube **300** may be configured to decompress a portion of flexible housing tube **300**. In one or more embodiments, a decompression of a portion of flexible housing tube **300** may be configured to cause flexible housing tube **300** to gradually straighten. Illustratively, a gradual straightening of flexible housing tube **300** may be configured to gradually straighten optic fiber **310**, e.g., from an optic fiber in a second partially straightened position **1120** to an optic fiber in a third partially straightened position **1130**. In one or more embodiments, a line tangent to optic fiber distal end **311** may intersect a line tangent to flexible housing tube proximal end **302** at a third partially straightened angle, e.g., when optic fiber **310** comprises an optic fiber in a third partially straightened position **1130**. Illustratively, the third partially straightened angle may comprise any angle less than the second partially straightened angle. For example, the third partially straightened angle may comprise a 45 degree angle.

FIG. **11**E illustrates an optic fiber in a fully straightened position **1140**. In one or more embodiments, a decompression of actuation structure **110** may be configured to gradually straighten optic fiber **310** from an optic fiber in a third partially straightened position **1130** to an optic fiber in a fully straightened position **1140**. Illustratively, a decompression of actuation structure **110** may be configured to rotate one or more links **170** about one or more link pins **180**. In one or more embodiments, a rotation of one or more links **170** about one or more link pins **180** may be configured to retract nosecone **105** relative to handle proximal end **702**. Illustratively, a retraction of nosecone **105** relative to handle proximal end **702** may be configured to retract flexible housing tube **300** relative to cable **810**. In one or more embodiments, a retraction of flexible housing tube **300** relative to cable **810** may be configured to reduce a force applied to a portion of flexible housing tube **300**, e.g., a portion of cable **810** fixed to flexible housing tube **300** may be configured to reduce a force applied to flexible housing tube **300**. Illustratively, a reduction of a force applied to a portion of flexible housing tube **300** may be configured to decompress a portion of flexible housing tube **300**. In one or more embodiments, a decompression of a portion of flexible housing tube **300** may be configured to cause flexible housing tube **300** to gradually straighten. Illustratively, a gradual straightening of flexible housing tube **300** may be configured to gradually straighten optic fiber **310**, e.g., from an optic fiber in a third partially straightened position **1130** to an optic fiber in a fully straightened position **1140**. In one or more embodiments, a line tangent to optic fiber distal end **311** may be parallel to a line tangent to flexible housing tube proximal end **302**, e.g., when optic fiber **310** comprises an optic fiber in a fully straightened position **1140**.

Illustratively, a surgeon may aim optic fiber distal end **311** at any of a plurality of targets within an eye, e.g., to perform a photocoagulation procedure, to illuminate a surgical target site, etc. For example, a surgeon may aim optic fiber distal end **311** at any of a plurality of targets within a human eye, e.g., to perform a photocoagulation procedure, to illuminate a surgical target site, etc. In one or more embodiments, a surgeon may aim optic fiber distal end **311** at any target within a particular transverse plane of the inner eye by, e.g., rotating handle **700** to orient flexible housing tube **300** in an orientation configured to cause a curvature of flexible housing tube **300** within the particular transverse plane of the inner eye and varying an amount of compression of actuation structure **110**. Illustratively, a surgeon may aim optic fiber distal end **311** at any target within a particular sagittal plane of the inner eye by, e.g., rotating handle **700** to orient flexible housing tube **300** in an orientation configured to cause a curvature of flexible housing tube **300** within the particular sagittal plane of the inner eye and varying an amount of compression of actuation structure **110**. In one or more embodiments, a surgeon may aim optic fiber distal end **311** at any target within a particular frontal plane of the inner eye by, e.g., varying an amount of actuation of compression of actuation structure **110** to orient a line tangent to optic fiber distal end **311** wherein the line tangent to optic fiber distal end **311** is within the particular frontal plane of the inner eye and rotating handle **700**. Illustratively, a surgeon may aim optic fiber distal end **311** at any target located outside of the particular transverse plane, the particular sagittal plane, and the particular frontal plane of the inner eye, e.g., by varying a rotational orientation of handle **700** and varying an amount of compression of actuation structure **110**. In one or more embodiments, a surgeon may aim optic fiber distal end **311** at any target of a plurality of targets within an eye, e.g., without increasing a length of a portion of a steerable laser probe within the eye. Illustratively, a surgeon may aim optic fiber distal end **311** at any target of a plurality of targets within an eye, e.g., without decreasing a length of a portion of a steerable laser probe within the eye.

The foregoing description has been directed to particular embodiments of this invention. It will be apparent; however, that other variations and modifications may be made to the described embodiments, with the attainment of some or all of their advantages. Specifically, it should be noted that the principles of the present invention may be implemented in any system. Furthermore, while this description has been written in terms of a surgical instrument, the teachings of the present invention are equally suitable to systems where the functionality may be employed. Therefore, it is the object of the appended claims to cover all such variations and modifications as come within the true spirit and scope of the invention.

What is claimed is:

1. An instrument comprising:

a handle having a handle distal end and a handle proximal end;

a piston having a piston distal end and a piston proximal end, the piston disposed in the handle;

an actuation structure of the handle having an actuation structure distal end and an actuation structure proximal end;

a nosecone having a housing tube housing;

a first link, the first link fixed to the actuation structure by a first link pin and the first link fixed to the nosecone by a second link pin;

a first spacer disposed over a portion of the first link pin extending from the first link, the first spacer configured to prevent movement of the first link relative to the first link pin;

a second spacer disposed over a portion of the second link pin extending from the first link, the second spacer configured to prevent movement of the first link relative to the second link pin;

a second link, the second link fixed to the actuation structure by a third link pin and the second link fixed to the nosecone by a fourth link pin;

a third spacer disposed over a portion of the third link pin extending from the second link, the third spacer configured to prevent movement of the second link relative to the third link pin;

a fourth spacer disposed over a portion of the fourth link pin extending from the second link, the fourth spacer configured to prevent movement of the second link relative to the fourth link pin;

a flexible housing tube having a flexible housing tube distal end and a flexible housing tube proximal end wherein the housing tube proximal end is disposed within the housing tube housing, the flexible housing tube having dimensions configured for performing ophthalmic surgical procedures, the flexible housing tube having an ultimate tensile strength in a range of 1000 to 1100 MPa; and

an optic fiber having an optic fiber distal end and an optic fiber proximal end, the optic fiber disposed in the actuation structure and the flexible housing tube wherein the optic fiber distal end is adjacent to the housing tube distal end and wherein a portion of the optic fiber is fixed to the housing tube.

2. The instrument of claim **1** wherein a compression of the actuation structure is configured to gradually curve the optic fiber more than 90 degrees relative to a line tangent to the flexible housing tube proximal end within a human eye.

3. The instrument of claim **2** wherein the compression of the actuation structure is configured to gradually curve the flexible housing tube.

4. The instrument of claim **3** wherein the compression of the actuation structure is configured to extend the flexible housing tube relative to the optic fiber.

5. The instrument of claim **3** wherein the compression of the actuation structure is configured to extend the nosecone relative to the actuation structure proximal end.

6. The instrument of claim **5** wherein the compression of the actuation is structure is configured to rotate the first link about the first link pin and rotate the second link about the third link pin.

7. The instrument of claim **5** wherein the compression of the actuation structure is configured to rotate the first link about the second link pin and rotate the second link about the fourth link pin.

8. The instrument of claim **1** wherein a decompression of the actuation structure is configured to gradually straighten the optic fiber more than 90 degrees relative to a line tangent to the flexible housing tube proximal end within a human eye.

9. The instrument of claim **8** wherein the decompression of the actuation structure is configured to gradually straighten the flexible housing tube.

10. The instrument of claim **1** further comprising:

a cable having a cable distal end and a cable proximal end, the cable disposed in the actuation structure and the flexible housing tube.

11. The instrument of claim **10** wherein a compression of the actuation structure is configured to gradually curve the optic fiber more than 90 degrees relative to a line tangent to the flexible housing tube proximal end within a human eye.

12. The instrument of claim **11** wherein the compression of the actuation structure is configured to gradually curve the flexible housing tube.

13. The instrument of claim **12** wherein the compression of the actuation structure is configured to extend the flexible housing tube relative to the cable.

14. The instrument of claim **12** wherein the compression of the actuation structure is configured to rotate the first link about the first link pin and rotate the second link about the third link pin.

15. The instrument of claim **12** wherein the compression of the actuation structure is configured to rotate the first link about the second link pin and rotate the second link about the fourth link pin.

16. The instrument of claim **10** wherein a decompression of the actuation structure is configured to gradually straighten the optic fiber more than 90 degrees relative to a line tangent to the flexible housing tube proximal end within a human eye.

17. The instrument of claim **16** wherein the decompression of the actuation structure is configured to gradually straighten the flexible housing tube.

18. The instrument of claim **17** wherein the decompression of the actuation structure is configured to retract the flexible housing tube relative to the cable.

19. The instrument of claim **10** further comprising:

a redundant cable having a redundant cable distal end and a redundant cable proximal end, the redundant cable disposed in the actuation structure and the flexible housing tube.

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